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Memorandum

To: Assistant Regional Director, Ecological Services, Regional Office, Sacramento, California

From: Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Intra-Service Biological Opinion on the Amendment to the San Bruno Mountain Habitat Conservation Plan

This memorandum represents the U.S. Fish and Wildlife Service's (Service) biological opinion on the Amendment for the San Bruno Mountain Habitat Conservation Plan. At issue are the effects of this action on the endangered San Bruno elfin butterfly (*Incisalia mossii bayensis*), endangered mission blue butterfly (*Icaricia icarioides missionensis*), endangered callippe silverspot butterfly (*Speyeria callippe callippe*), endangered San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), threatened Bay checkerspot butterfly (*Euphydryas editha bayensis*), critical habitat for the threatened Bay checkerspot butterfly, and the endangered San Francisco lessingia (*Lessingia germanorum*). This biological opinion is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 *et seq.*)(Act).

This biological opinion is based on: (1) Final Rule listing the callippe silverspot butterfly as an endangered species that was published in the **Federal Register** on December 5, 1997;(2) *Application for an Amendment to the section 10(a)(1)(B) permit for San Bruno Mountain (PRT 2-9818)* dated February 5, 2008, from the City of Brisbane and associated material that was received by the Service on February 7, 2008; (3) *San Bruno Mountain Habitat Management Plan 2007* dated September 2007 that was prepared by the San Mateo County Parks Department; (4) *San Bruno Mountain Area Habitat Conservation Plan* (volumes 1 and 2) dated May 1982, that was prepared by the San Bruno Mountain Habitat Conservation Plan Steering Committee; 5) *Biological Study and Analysis of Conserved Habitat for Amendments to the Habitat Conservation Plan for San Bruno Mountain and Incidental Take Permit PRT 2-9818* dated October 2007 that was prepared for the County of San Mateo and City of Brisbane; (6) *Analysis of Butterfly Survey Data and Methodology from San Bruno Mountain Habitat Conservation Plan (1982-2000) 1. Status and Trends* dated 2004, that was prepared by Travis Longcore, Christine S. Lam, and John P, Wilson; (7) *San Bruno Mountain Habitat Conservation Plan Amendment*

Environmental Assessment dated October 2007 that was prepared by Jones and Stokes; (8) electronic mail, telephone discussions, and meetings between the Service, City of Brisbane, Brookfield Homes, Thomas Reid Associates, and others, between 1998 and 2008; and (9) other information available to the Service.

Consultation History

December 5, 1997:	The Service listed the callippe silverspot butterfly as an endangered species.
February 7, 2008:	The Service received the application for the Amendment to the San Bruno Mountain Habitat Conservation Plan dated February 5, 2008, from the City of Brisbane.
1998-2008:	The Service sent and received electronic mail, telephone discussions, and meetings with the City of Brisbane, Brookfield Homes, Thomas Reid Associates, and others regarding the Amendment.

Project Description

San Bruno Mountain is a small range in San Mateo County, California, with a length of about four miles, a width of 1-2 miles, and a maximum height of 1300 feet, that is entirely surrounded by the San Francisco metropolis of Daly City, South San Francisco, County of San Mateo, and City of Brisbane. . It is comprised of two nearly parallel ranges separated by Guadalupe Valley (= Industrial Valley) and united by a flat area known as the Saddle. The bulk of the mountain is composed of late Cretaceous dark green graywrackle rocks of the Franciscan formation (McClintock *et al.* 1990). The climate varies greatly over this small area, which plays a major role in the distribution and ecology of the native flora and fauna. San Bruno Mountain often experiences heavy winds, particularly in the summer. Heavy fog often envelopes the western half of San Bruno Mountain, especially in July and August. The five distinct vegetation communities described in the San Bruno Mountain Habitat Conservation Plan are non-native, grassland, coastal scrub, foothill woodland, and freshwater marsh (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982).

The San Bruno Mountain Habitat Conservation Plan (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982) was permitted on March 4,1983 (PRT 2-9818), and was the first habitat conservation plan approved in the Nation. It allowed for limited development on San Bruno Mountain, while setting aside grassland habitat for rare butterfly species, including the San Bruno elfin butterfly, mission blue butterfly, callippe silverspot butterfly, and the San Francisco garter snake.

Incidental take of the mission blue butterfly by development activities on San Bruno Mountain was covered by the 1983 incidental take permit. Because of its rarity, incidental take authorization of the San Bruno elfin butterfly was restricted to areas outside of the nine populations on the Mountain known to exist at the time of permit issuance. Although the callippe silverspot butterfly was not listed at the time of permit issuance, the animal was a focal species

of the habitat conservation plan and the plan evaluated its potential impacts on the species. The Bay checkerspot butterfly was an inhabitant of San Bruno Mountain when the habitat conservation plan was prepared, but the animal was not listed at that time.

Management of conservation lands under the San Bruno Mountain Habitat Conservation Plan has concentrated on controlling exotic species, predominantly large woody species, including gorse (*Ulex europaea*), eucalyptus (*Eucalyptus* species), French broom (*Genista monspessulana*), and Scotch broom (*Cytisus scoparius*) (San Mateo County Parks Department 2007). Various mechanical means were used to control gorse from 1982 to 1985, including burning, chainsaws, discing, chaining by bulldozers, and hand control (Thomas Reid Associates 1983, 1985a). Most gorse resprouted, so RoundUp®, a herbicide, was used in 1986 (Thomas Reid Associates 1986). Herbicide spraying and discing was conducted in 1987 and 1988 (Thomas Reid Associates 1987). Fennel (*Foeniculum vulgare*) was also included in weed control in 1987 due to an increase in the amount of area invaded by this plant (Thomas Reid Associates 1988). In subsequent years, controlled burns and further herbicide spraying targeted gorse, and hand removal was used for French broom, Scotch broom, gorse, fennel, iceplant (*Carpobrotus edulis*)(Thomas Reid Associates 1990a, 1992). Formal exotic species management plans were prepared in 1992, for these plants and eucalyptus (Thomas Reid Associates 1993). The use of two other herbicides, Garlon 4®, and Aquamaster®, was implemented because of their high effectiveness, low toxicity, and short half-life in the soil (Santa Mateo County Parks Department 2008).

The Amendment to the San Bruno Mountain Habitat Conservation Plan would: 1) adjust the boundaries of Conserved Habitat within the Northeast Ridge (Administrative Parcel 1-07); 2) provide significant supplemental habitat conservation plan funding provisions that would allow additional critical management and monitoring activities; and 3) add the callippe silverspot butterfly and Bay checkerspot butterfly to the list of species covered by the incidental take permit to allow for completion of the Northeast Ridge development and allow the use of more effective habitat management techniques on San Bruno Mountain. Management and Monitoring of Conserved Habitat is a component of the existing Habitat Conservation Plan, as such, it is not part of the Proposed Action. However, this Biological Opinion analyses effects resulting from Management and Monitoring on the callippe silverspot and Bay checkerspot butterflies.

Prior Development within the Northeast Ridge.

The Northeast Ridge (Habitat Conservation Plan [= HCP] Administrative Parcel 1-07), covers 228 acres located in the northeast corner of San Bruno Mountain. It is bounded on the south by the Crocker Industrial Park, on the north and east by Guadalupe Canyon Parkway and on the west by a PG&E transmission line and open space lands to be dedicated as Conserved Habitat. It has a hilly terrain that contains four vegetation types: annual grassland, coastal scrub, riparian scrub, and introduced invasive species, including blue gum eucalyptus (*Eucalyptus globulus)*, French broom, and fennel.

The Northeast Ridge was designated a Planned Parcel in the San Bruno Mountain Habitat Conservation Plan (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982). The City of Brisbane approved a tentative map in 1982 for development of 1,250 residential

units within this Administrative Parcel. A revised project was subsequently submitted to Brisbane for consideration. The revisions included a change in the type and location of homes and reduced the total number of dwelling units to 579 in two phases, with Unit I having 411 units and Unit II having 168 units. The revised project also was phased over time. In 1989, the City approved a vesting tentative map ("1989 Vesting Tentative Map") for the revised project, and the Service approved an Equivalent Exchange Amendment for this revised design in 1990. Over 135 acres were to be dedicated as Conserved Habitat.

Consistent with these approvals, portions of the Northeast Ridge were developed with homes and associated infrastructure. Unit I, the first development phase, included three residential neighborhoods, known as Neighborhoods I, II, and III, with 411 dwelling units and community facilities. In total, development of Unit I, which is substantially built and occupied, permanently disturbed 66.99 acres, and 66.39 acres of lands were dedicated as Conserved Habitat..

After the callippe silverspot butterfly was listed as an endangered species in 1997, Brookfield Northeast Ridge II, the City of Brisbane, and the County of San Mateo worked with the Service to consider the feasibility of further avoidance and minimization of potential impacts from the development of Unit II, the second and final phase. These changes are reflected in the 2007 Vesting Tentative Map, as described more fully below. The 2007 Vesting Tentative Map increases the size of the Conserved Habitat within the Northeast Ridge by 8.93 acres and reduces the amount of temporary disturbance by 11.43 acres. Overall, ground disturbances are reduced by 20.36 acres compared to the 1989 Vesting Tentative Map.

In 2007, grading to construct a road, repair drainage features and conduct associated slope stabilization measures was conducted within a 6.74-acre area north of Unit I. Approximately 5.67 acres of this area had been previously disturbed by grading related to construction of Unit I in 1995 and 1996. The City of Brisbane determined repairs were necessary for public health, safety and welfare reasons on approximately 1.07 acres in previously undisturbed area outside the Habitat Conservation Plan fence location at that time. Prior to Brisbane's approval of construction, it informed the Service of the proposed relocation of the fence and that grading would occur in previously undisturbed areas, and the work was disclosed through the Site Activity Permit notification process. The Site Activity review also described mitigation for impacts to habitat, which was consistent with those proposed for activities covered by these Amendments. The Service advised the City of Brisbane that we do not impede activities that are necessary to prevent loss of human life or property.

Between 2006 and 2008, 17 houses were constructed in previously disturbed areas, including the area disturbed by the City-required infrastructure improvements. In total, 428 dwelling units have been constructed in the Northeast Ridge.

Existing approvals related to the 1989 Vesting Tentative Map required removal and thinning of a grove of eucalyptus trees located within the proposed development area and proposed Conserved Habitat. Removal and thinning of the grove had been delayed due to the listing of the callippe silverspot butterfly, but were carried out prior to the start of avian nesting season in the fall and winter of 2007-2008, pursuant to existing approvals. Tree removal was carried out after

completion of a raptor survey and under the supervision of the Habitat Manager to ensure that there was no take of *Speyeria callippe callippe*.

Activities Covered by the Amendment to the San Bruno Mountain Habitat Conservation Plan

I. Reconfiguration of Conserved Habitat and Proposed Development within the Northeast Ridge.

Unit II was approved under the 1989 Vesting Tentative Map and the 1990 Equivalent Exchange Amendment, and it included development of two additional neighborhoods, Neighborhoods I and II (Hillcrest and Landmark), with a total of 168 dwelling units in approximately 25.6 acres and an additional 14.4 acres of temporary disturbance. The proposed reconfiguration in the 2007 Vesting Tentative Map abandoned development within 21.2-acre Neighborhood I in order to avoid impacts to habitat along the hilltop and to reconfigure development of Neighborhood II to reduce impacts to the habitat of the callippe silverspot butterfly. As reconfigured, Neighborhood II would disturb approximately 19.64 acres, and approximately 78.27 acres would be designated as Conserved Habitat.

Grading for development of the 19.64-acre Unit II, Neighborhood II will permanently disturb 16.67 acres and temporarily disturb 2.97 acres that will be revegetated according to the San Bruno Mountain Habitat Conservation Plan. This includes 1.07 acres of previously undisturbed area with coastal scrub, native and non-native shrubs, and grassland that was impacted by the installation of City of Brisbane -required utilities. Grading, construction, use, and maintenance of 71 single-family detached home lots, including association common areas and City-owned emergency vehicle access and roadways within the permanently disturbed areas. A fuel management zone covering 1.44 acres will extend from portions of the developed area. Approximately 1.03 acres of the fuel management zone will be located within the temporarily disturbed areas that will be restored pursuant to the San Bruno Mountain Habitat Conservation Plan; the remaining 0.41 acre is located within otherwise undisturbed areas. As required by the City, the fuel management zone will not be irrigated and will be periodically maintained by removing woody vegetation. Concrete v-ditches will be installed on the graded and restored slopes at the perimeter of the wet landscaping area on the property to convey storm water runoff. Where they occur within restored areas that become part of the Conserved Habitat, maintenance within the fuel management zone and of the drainage improvements will be funded by the development's homeowners association and will be carried out in coordination with the Habitat Manager through the Site Activity review process in order to avoid and minimize potential impacts to sensitive habitat.

The primary access to the 2007 Vesting Tentative Map development will be from the south via existing streets in the adjacent community (Unit I, Neighborhood II). An emergency vehicle access approximately 20 feet wide and 180 feet long will connect the northern corner of the community ("C" Court cul-de-sac) to Guadalupe Canyon Parkway. Access to this roadway, which will be concrete, will be limited by locked gates to emergency vehicles only.

Portions of the perimeter of the community may have a 4-foot high catchment walls and retaining walls where lots and roadways are adjacent to the Conserved Habitat. These walls may reduce the amount of grading needed to stabilize the slopes, thereby minimizing impacts to existing grassland habitat. The areas where walls may be placed include a portion of "C" Court in the northern tip of the development and the easterly edge of "A" Street in the southern end of the development.

Other development-related activities covered by the Amendment include:

1. Thinning and removal of the remaining trees within the eucalyptus grove.

2. Landscaping and maintenance of common areas, including revegetation and management of temporarily disturbed areas and installation and maintenance of fuel management zones following the San Bruno Mountain Habitat Conservation Plan.

3. Installation, operation, and maintenance of required public or association-owned infrastructure, sidewalks, community fencing or walls, streetlights, traffic signs and signals, drainage facilities (including concrete v-ditches), and utilities (including, but not limited to, water, sewer, electricity, gas, telephone, and cable).

4. Monitoring required for the installation, construction, or operation and maintenance of any of the features described in this section.

The Amendment will contain the following funding elements for the San Bruno Mountain Habitat Conservation Plan:

1. Each unit in 2007 Vesting Tentative Map will pay the existing annual San Bruno Mountain Habitat Conservation Plan charge, adjusted annually for inflation in accordance to the Employment Cost Index – West or its successor, as reported by the U.S. Department of Labor's Bureau of Labor Statistics, plus a fixed charge of $716.73. In 2008, the total San Bruno Mountain Habitat Conservation Plan fees paid under the 2007 Vesting Tentative Map (and on the 17 units that were constructed between 2006 and 2008) would be $808.09. The additional fixed charge represents a substantial increase to the amount required under the San Bruno Mountain Habitat Conservation Plan. Brookfield Northeast Ridge II will fund a $4,000,000.00 non-wasting endowment to be managed by the Trustees for the San Bruno Mountain Habitat Conservation Plan for the ongoing habitat management and monitoring activities. The endowment is to be funded incrementally pursuant to an agreement with the City of Brisbane. Including the contributions that have already been paid for the 17 homes that were recently constructed, the endowment will total $4,000,000.00 and is expected to generate approximately $200,000.00 per year in interest for the San Bruno Mountain Habitat Conservation Plan Trust.

2. Brookfield Northeast Ridge II will fund a $4,000,000.00 non-wasting endowment to be managed by the Trustees for the San Bruno Mountain Habitat Conservation Plan for the ongoing habitat management and monitoring activities. The endowment is to be funded incrementally pursuant to an agreement with the City of Brisbane. Including the contributions that have already been paid for the 17 homes that were recently constructed, the endowment will total $4 million and is expected to generate approximately $200,000.00 per year in interest for the San Bruno Mountain Habitat Conservation Plan Trust.

3. Brookfield Northeast Ridge II will fund the management of the restored Conserved Habitat for a period that extends 5 years after the completion of grading and revegetation in these areas.

The combined sum of the funding provided by the 2007 Vesting Tentative Map proposal, including both the higher annual San Bruno Mountain Habitat Conservation Plan charges and the interest from the endowment, would increase the San Bruno Mountain Habitat Conservation Plan annual revenues utilized for habitat management by approximately $275,000.00 per year (2007 dollars). In 2007, San Bruno Mountain Habitat Conservation Plan revenues for habitat management and monitoring are approximately $130,000.00 per year. The enhanced management would be done in accordance with the Habitat Management Plan.

II. Management and Monitoring of Conserved Habitat

The Amendment will add the callippe silverspot butterfly and Bay checkerspot butterfly to the incidental take permit for the San Bruno Mountain Habitat Conservation Plan. The incidental take would occur during management and monitoring activities within existing and proposed Conserved Habitat. The additional funding provided through the Amendment will allow enhancement and management of the existing grasslands for endangered species, especially *Speyeria callippe callippe*, and it will provide funding for a grazing and brush control program that will improve the San Bruno Mountain ecosystem for the benefit of the covered species.

The management and monitoring activities in the Habitat Management Plan include the following activities:

1. Vegetation Management Activities

San Bruno Mountain currently contains approximately 2,730 acres of Conserved Habitat, including parks and land dedicated for the avoidance of impacts to rare species. These areas contain habitat for the listed butterflies, as well as other listed and imperiled species. Habitat management activities are authorized under the San Bruno Mountain Habitat Conservation Plan, and since the 1990s, habitat maintenance has been guided by management plans, which had been updated every five

years. Periodic revision of the management plans has allowed the implementation of adaptive management.

The Habitat Management Plan contains components for adaptive management, but it is designed as a long-term management plan to be revised as needed rather than updated every five years. It divides San Bruno Mountain into 13 management units. Land within each unit is prioritized into four categories. Priority 1 areas, which cover approximately 1,292 acres extending across San Bruno Mountain, cover the core habitats for the listed butterflies. It consists of primarily of grassland habitat, but also includes areas of coastal scrub. Priority 2 areas, which contain 495 acres, cover additional grassland habitat and areas of grassland habitat that have converted to coastal scrub since implementation of the San Bruno Mountain Habitat Conservation Plan. These areas often provide important movement corridors for listed butterflies. Priority 3 areas, containing 884 acres, include coastal scrub habitat and native oak woodlands and riparian areas, which only provide limited habitat for the listed butterflies. Priority 4 areas, containing 248 acres, are areas with significant, dense infestations of invasives, including eucalyptus, gorse, and French broom. The Habitat Management Plan focuses on containing exotic invasive plants within these areas and recommends, because of the expense involved, that removal and restoration be pursued using grant funds or other funding sources not generated through the San Bruno Mountain Habitat Conservation Plan.

Within each unit, specific management activities are prescribed to counteract processes, such as brush succession, build up of thatch and non-native species invasion that adversely affect the amount and quality of the grassland habitat on San Bruno Mountain. Techniques include the following activities:

a. *Hand Work:* Hand removal of invasive plants is used to eliminate clusters of invasive plants, especially seedlings and plants whose root structure is not prohibitively deep or large. Hand removal involves identifying the target species and then utilizing work crews to pull plants out of the ground, use a weed wrench to remove bigger ones, or cut them down with an ax maddox or chain saw. The plants removed are piled up and either manually removed, burned, or allowed to decompose over time. Hand removal of weeds has the benefit of selectively removing weed biomass from sensitive areas.

b. *Flaming:* Flaming involves using a gas torch to pass intense heat over the leafy parts of an undesirable plant. It can be used on young, emerging weeds without affecting established, desirable plants and it leaves no residue. Flaming is not effective on weeds

with underground reserves. Flaming may be effective on invasive species, such as French broom, and only is used during the wet season during appropriate conditions.

c. *Herbicide Application:* Herbicide control typically is used on mature, dense stands of invasive plant species that are more cost effective to spray than remove by hand. Most invasive pest plant infestations are treated with herbicide 2 to 3 times per year by foliar spraying. Commonly used herbicides include Roundup® and Garlon®. The initial treatment typically has a 95% kill rate followed up with routine maintenance every six to twelve months for up to three years until the infestation is eliminated. Herbicide application is conducted on San Bruno Mountain because it can be conducted more effectively than handwork and is it is more cost effective. Herbicide application over successive years, however, can create a dense layer of thatch, and this additional biomass on the soil tends to favor colonization by non-native annual grasses, herbaceous weeds, and coastal scrub succession.

d. *Livestock Grazing:* Grazing is the utilization of grassland (forage) by domestic livestock such as cattle (*Bos bos*), sheep (*Ovies aries*), goats (*Capra aegargus hircus*), or horses (*Equus ferus caballus*). Where appropriate, re-introduction of grazing can be an effective means of maintaining the grassland habitat by reducing brush and tall annual grasses which out-compete native grassland plants, including the butterfly host plants. Grazing has yet to be used on a large scale on San Bruno Mountain for habitat enhancement purposes. Depending upon a variety of factors, grazing can have a positive impact, such as providing conditions beneficial for native plant species, or negative impacts, such as increasing the amount of exotic invasive plants and erosion. Grazing affects soil compaction, soil nutrients, light, and both native and normative vegetation. The number and types of animals, duration and frequency of grazing events, and vegetation type influence the results on the environment. The species of livestock is a critical factor due to the variation in diet preferences. There may be visible improvements that are immediately visible from grazing, it generally requires 2-4 years to obtain significant results. Over time, a consistent practice of grazing in the early spring can result in reduction of weedy annuals and an increase in the amount of native grassland and native annual wildflowers and other plants. Grazing also can be utilized as an effective tool for managing fire buffers.

e. *Prescribed Burning:* Prescribed burning is defined as fire applied in a controlled manner to fuels on a specific land area to

accomplish predetermined, well-defined management objectives. The introduction of a burning regime similar to the pre-European conditions on San Bruno Mountain could be instrumental in achieving long-term sustainability of its grasslands and listed butterfly habitat. However, because it is an open space area surrounded by dense urbanization, implementing fire as a habitat management tool on a regular basis, if even at all, is not an option for habitat managers. Given these constraints, micro-burns that are a few hundred square feet or less in size may be feasible. These small burns can be utilized to control localized weed or scrub infestations or thatch build-up. To be an effective tool for the maintenance of grasslands, micro-burns would need to be conducted in the summer or fall to meet grassland maintenance goals. If micro-burning is implemented for managing vegetation on San Bruno Mountain, it would only occur under the direction of the California Department of Forestry and Fire Protection (CalFire), County of San Mateo, Bay Area Air Quality Management District, and local fire departments. In addition, any burning conducted must be consistent with the *San Bruno Mountain Community Wildfire Protection & Fire Use Plan* (CalFire and Thomas Reid Associates 2005).

f. *Pile Burning:* Pile or slash burning is an integral part of the habitat management program. This technique is used to reduce the accumulation of brush (wildfire fuels), and to decrease coastal scrub habitat and invasive species. Pile burning can be conducted safely during the winter months when the surrounding vegetation is wet, fuel moisture levels are high, and the risk of fire escape is negligible. Combined with mowing and/or grazing, it is an excellent technique for opening up areas for conversion to grassland and for preparing areas for restoration. Post disturbance follow-up weed control is used to the flush of weeds that may occur following clearing and pile burning activities.

g. *Mowing:* Mowing is an effective tool that is used frequently as part of the current ongoing habitat management of San Bruno Mountain. Mowing is used to depress woody and weedy invasive species in the same manner as grazing and burning. Mowing has been found to be effective at reducing annual grasses and providing a competitive advantage to native species, including the larvae food plants for the mission blue butterfly. It is especially useful for avoiding rare species within highly sensitive areas. It cannot effectively be implemented on a large scale to address annual invasive species. Mowing is conducted repeatedly, 2 to 4 times per year, and prior to invasive species seed set. Mowing can

be done with a tractor mower for large areas, or with a weed-eater for small areas.

h. *Mechanical Clearing:* Clearing of appropriate brush and trees, such as broom, gorse, coyote brush, Monterey pine (*Pinus radiata*) and eucalyptus may be accomplished by mechanical clearing. Private contractors, the California Conservation Corps, County Fire Safe crews, and California Department of Forestry prison crews have been used for brush clearing projects on San Bruno Mountain. Mechanical methods for brush and tree removal generally is a higher cost than other techniques. A "Brontosaurus," a large cutting head mounted on a tracked caterpillar, can effectively remove brush where hand removal or grazing is not feasible. This machine removes and chips brush and small trees in a single operation. Mechanical clearing must be conducted carefully to minimize soil disturbance.

i. *Replanting/Restoration:* Restoration activities on San Bruno Mountain includes re-seeding, Mycorrhizal inoculation, nutrient fixation, and replanting. In areas that have long been dominated by invasives, the density of the native seed in the soil may be reduced or non-existent. Re-seeding with locally grown, native seed can be used in specific areas that have had invasive species control work, a high erosion potential and/or are located within habitat restoration islands. Mycorrhizal inoculation may include reintroduction of fungi, which grow into the root tip cells of the plants and form a symbiotic relationship with them, to coastal sage scrub restoration sites. Nutrient fixation can be done through the addition of recalcitrant mulch, such as bark or wood chips, to the soil. Replanting has been used on San Bruno Mountain when areas have been properly selected and when thorough follow up work has been done to protect plantings. Smaller habitat islands, approximately 1 acre or less, are managed more easily, and can provide habitat for the endangered species once plants are established and maintained for a few years (Thomas Reid Associates 2007).

2. Monitoring Activities

The San Bruno Mountain Habitat Conservation Plan requires monitoring to ensure compliance with the terms of the section 10(a)(1)(B) permit and to evaluate the effectiveness of the ongoing conservation efforts. Monitoring includes recording of regular observations of biological processes and conservation activities. This allows the Plan Operator to conduct periodic re-evaluation of the vegetation management activities underway and modify them as appropriate. Monitoring is structured to

provide sufficient information for ongoing review. The intensity of monitoring depends upon the goals of the monitoring, and corresponds to the scale of activities being evaluated (e.g., construction and/or management techniques).

Most monitoring activities are conducted by the Habitat Manager. Any monitoring, including research, carried out by other entities or individuals is coordinated with the Habitat Manager through the Site Activity Permit process of the San Bruno Mountain Habitat Conservation Plan

The San Bruno Mountain Habitat Conservation Plan does not detail specific monitoring methods. The Habitat Management Plan's monitoring program is intended to implement monitoring based on the best scientific and commercial information available. As described in the Habitat Management Plan, monitoring consists of recording the relative abundance of the listed butterflies and their habitat over time. The Habitat Management Plan includes the following monitoring methods.

a. *Endangered Butterfly Monitoring*: The monitoring of listed butterflies conducted over the 26-year span of the San Bruno Mountain Habitat Conservation Plan focused on assessing the distribution and/or relative abundance of the mission blue butterfly, callippe silverspot butterfly, and San Bruno elfin butterfly on San Bruno Mountain. All three of these listed species, and the animals overlap in their distribution at the site. Two procedures have been used to monitor the status of endangered species on the Mountain: set transects and wandering transects. The Habitat Management Plan utilizes a set transect monitoring system. No capture and/or marking of any of the four listed butterflies are part of the monitoring program on San Bruno Mountain.

b. *Rare Plant Surveys*: Rare plant distribution data has been collected in GIS format within the last 5 years for listed and non-listed plant species with very limited distribution on San Bruno Mountain. This includes all of the manzanita species on San Bruno Mountain (*Arctostaphylos ssp.*), Diablo rock rose (*Helianthella castanea*), endangered San Francisco lessingia, San Francisco spineflower (*Chorizanthe cuspidata var. cuspidata*), San Francisco campion (*Silene verecunda ssp. verecunda*), and dune tansy (*Tanacetum camphoratum*). The Habitat Management Plan includes GPS mapping of all the special status rare plant species once every three years on San Bruno Mountain to track changes in their distribution and status.

c. *Monitoring of Additional Species*: Academic research and monitoring will be encouraged on additional species (e.g., bumblebees and ants) on San Bruno Mountain.

d. *Vegetation Management Effectiveness Monitoring*: Monitoring vegetation is vital to recognizing changes to the habitats on San Bruno Mountain. Monitoring the habitat over the 25-year span of the San Bruno Mountain Habitat Conservation Plan has been focused on tracking invasive species distribution and coastal scrub succession. Vegetation monitoring has been done using two methods: daily tracking of work conducted and overall distribution of vegetation types and invasive species. To track large scale changes in vegetation, the Habitat Management Plan includes mapping using aerial ortho-photo interpretation and field checking, and it be remapped using this technique every 5 years. For finer scale monitoring, fixed transects, quadrats, and/or other methods are utilized by the Habitat Manager.

Analytical Framework for the Jeopardy and Adverse Modification Analyses

Jeopardy Determinations

In accordance with policy and regulation, the jeopardy analysis in this Biological Opinion relies on four components: (1) the *Status of the Species and Environmental Baseline*, which evaluates the San Francisco garter snake, mission blue butterfly, San Bruno elfin butterfly, callippe silverspot butterfly, and San Francisco lessingia range-wide conditions, the factors responsible for that condition, and their survival and recovery needs; and evaluates the condition of these listed species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of these four animals and plant; (2) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on these species; and (3) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on them.

In accordance with policy and regulation, this jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the San Francisco garter snake, mission blue butterfly, San Bruno elfin butterfly, callippe silverspot butterfly, and San Francisco lessingia cuurent status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of any of these five species in the wild.

The jeopardy analysis in this Biological Opinion places an emphasis on consideration of the range-wide survival and recovery of the callippe silverspot butterfly, mission blue butterfly, San Bruno elfin butterfly, Bay checkerspot butterfly, San Francisco garter snake, and the San Francisco lessingia and the role of the action area in the survival and recovery of these five listed species as the context for evaluating the significance of the effects of the proposed Federal

action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This biological opinion on the critical habitat for the Bay checkerspot butterfly does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR § 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to the critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Biological Opinion relies on four components: (1) the *Bay checkerspot Butterfly Critical Habitat*, which evaluates the range wide condition of designated critical habitat for the Bay checkerspot butterfly in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; and evaluates the condition of critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (2) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on PCEs and how that will influence the recovery role of affected critical habitat units; and (3) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on Bay checkerspot butterfly critical habitat are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the Bay checkerspot butterfly.

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of Bay checkerspot butterfly critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of effects f the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

Status of the Species and Environmental Baseline

Callippe Silverspot Butterfly

The callippe silverspot butterfly was proposed for listing as an endangered species in 1978 (Service 1978), but the proposal was retracted in 1979 (Service 1979) following substantive changes to the Act. Another proposal to list this butterfly was published in 1980, but it was not completed because of procedural limitations. A petition to list the animal was submitted to the Service in 1991, a proposed rule was published in 1994 (Service 1994), and a final rule listing the species as endangered was published on December 5, 1997 (Service 1997).

This species is a medium sized butterfly in the family Nymphalidae, or brush-footed butterflies. It has a wingspan of approximately 2.2 inches. The upper wings are brown with extensive black spots and lines, and the basal areas are extremely melanic. The undersides of the wings are brown, orange-brown, and tan with black lines and distinctive black and bright silver spots. Basal areas of the wings and body are densely pubescent.

The callippe silverspot butterfly is endemic to the grassy hills surrounding the San Francisco Bay. It currently is known from San Bruno Mountain and Sign Hill in South San Francisco in San Mateo County, the hills near Pleasanton in Alameda County, and the hills between Vallejo and Cordelia (e.g., Solano Land Trust property near State Route 680 and Vallejo Swett Ranch [Arnold 2007a], Hunter Hill, St. Johns Mine Road, and Lake Herman) in Solano County.

Since it was first collected in San Francisco, California in the 1800's (dos Passos and Grey 1947), the callippe silverspot butterfly has been recorded from just above sea level to over 1,400 feet elevation. The animal occurs in grasslands with California golden violet, also known as Johnny jump-up (*Viola pedunculata*), which is its sole larval foodplant (Thomas Reid Associates 1982; Service 1997). Although this plant is found in grasslands, coastal sage scrub, oak woodlands, and dunes throughout much of California, the callippe silverspot butterfly is limited to the fog-influenced locations in the San Francisco Bay area.

Arnold (1983*a*) presented a revision of the subspecies of *Speyeria callippe*. His conclusions were based on quantitative analysis of eight wing characteristics. He failed to detect concordant geographic variation in seven of the eight characteristics; therefore, he limited his taxonomic description to the color of the ventral disc only (Arnold 1981; Arnold 1983*a*; Arnold 1985). Arnold (1985) lumped 10 of the previously recognized subspecies of *Speyeria callippe* (including *Speyeria callippe callippe*) under the single subspecies name *Speyeria callippe callippe*. This revised taxonomy of *Speyeria callippe callippe* incorporated the geographic distributions of all the previously-recognized subspecies that were merged into it, giving what he considered *Speyeria callippe callippe* to have a geographic distribution ranging from the Trinity Alps in northern California to San Diego in southern California (Arnold 1985).

Arnold's (1985) revision has not been widely accepted by professional lepidopterists (Emmel *et al.* 1998a; Emmel *et al.* 1998c). Hammond (1986) presented a detailed critique of the revision and its methodology, questioning the choice of characteristics and the philosophic approach to taxonomy that were relied upon by Arnold (1983*a*). In a review of rare California butterflies, Murphy and Weiss (undated) stated that they did not know of any lepidopterists who accepted Arnold's (1983*a*) taxonomy of *Speyeria callippe*.

The callippe silverspot butterfly is univoltine. During the early summer flight season, the adult females lay their eggs. Arnold (1981) claimed that callippe silverspot butterflies lay their eggs on the undersides of leaves and stems of Johnny jump up, but this has been contradicted by other researchers, who have reported that the animals typically lay their eggs in the vicinity of *Viola pedunculata*, but not on it (Mattoon *et al.* 1971; Thomas Reid Associates 1982). They reported that females oviposit on dirt, dry grass, mixed plant debris, and rodent trails and holes near the larvae foodplant (Thomas Reid Associates 1982). Females observed at San Bruno Mountain did not touch any *Viola pedunculata*, but laid all of their eggs within a few inches of these plants,

and no more than 3 feet away (Thomas Reid Associates 1982). Other silverspot butterfly species, such as the regal fritillary butterfly (*Speyeria idalia*), avoid laying eggs on their host plant (Kopper *et al.* 2000). Each female callippe silverspot butterfly can produce more than 600 eggs (Mattoon *et al.* 1971). The number of eggs produced per day by female mormon silverspot butterflies (*Speyeria mormonia*) decreases over their lifespan (Boggs 1986); the callippe silverspot butterfly likely has a similar physiology.

Larvae hatch from the eggs in about a week (Arnold 1981). After hatching, larvae eat the lining of the eggshell, take shelter in ground litter, and then enter diapause (Mattoon *et al.* 1971; Arnold 1981). Diapause is a resting state that enables larvae to maintain a low metabolic rate and it may occur during periods when the foodplants are not available. Most callippe silverspot butterfly larvae remain in diapause from early summer until the following spring, but some briefly interrupt diapause by seeking shelter from adverse conditions during this period, followed by a return to diapause (Mattoon *et al.* 1971). The callippe silverspot butterfly larvae then develop through five instars (Arnold 1981). The mature larva is black with two mid-dorsal narrow yellow stripes. The dorsal surface has protuberances that bear spines.

After diapause, larvae eat the leaves of their foodplant, but not the sympatric early blue violet (*Viola adunca*) (Arnold 1981). Johnny jump up is a low-growing, yellow-flowered violet that blooms from early January through April. Studies have found no significant relationship between this plant species' abundance and soil depth, moisture storage, pH, clay content, or microclimate (Thomas Reid Associates 1982), therefore it is not known what affects the abundance of this food plant. A limited food source can result in low larval body mass, slow growth, and low survival (Poston *et al.* 1977; Poston *et al.* 1978). Kelly and Debinski (1998) found that areas with low host plant density supported smaller regal silverspot adults than areas with high host plant density, and this relationship likely applies to the related callippe silverspot butterfly.

It is likely that callippe silverspot butterfly larvae, as observed for other *Speyeria* species, feed quickly and then crawl to hiding places (Kopper *et al.* 2001). No measurements of callippe silverspot butterfly larval movements are available. However, we know that the distance traveled by butterfly larvae depends on the developmental stage. A first instar callippe silverspot butterfly larva is approximately 0.05 to 0.10 inches in length. Due to the complex texture of grassland vegetation and soil, a larva of this size would need to travel 138 feet up and down the surfaces of plants and soil clumps to cover a linear distance of 3.3 feet (Weiss and Murphy 1988). A fifth instar regal fritillary butterfly larva moved 79 linear feet in 24 hours, but missed many violets that were inches away from its path but not directly on it (Kopper *et al.* 2001). It is likely that the fifth instar larvae of the callippe silverspot butterfly are capable of similar movements in their search for host plants and pupation sites.

Callippe silverspot butterfly larvae experience a high rate of mortality during the first instar diapause stage due to adverse environmental conditions (Mattoon *et al.* 1971, undated). They also have a pronounced sensitivity to some pesticides (Mattoon *et al.* 1971). Plants exposed to pesticides 6 weeks earlier and subsequently washed before being fed to larvae still caused rapid death (Sterling Mattoon undated). Arnold (1981) reported that callippe silverspot butterfly

larvae are attacked by ichneumonid wasps, but the significance of parasites and parasitoids as a limiting factor for abundance is unknown.

Collectors have used the presence of bracken fern (*Pteridium aquilinum*) as an indicator of sites that would support the callippe silverspot butterfly's host plant (J.W. Tilden, *in litt.* 1978). When this correlation was investigated in the field, it was concluded that while the two species were found together in mesic locations, and Johnny jump up was more robust in those locations, the relationship between them was coincidental and not causal (Thomas Reid Associates 1982). Therefore, while bracken fern may indicate mesic areas where robust *Viola pedunculata* might be found, it is not a habitat component, and host plants are regularly found in areas lacking bracken fern.

No information is available about the minimum size or density of host plant that stimulates oviposition in female callippe silverspot butterflies, either on local or landscape scales. In other *Speyeria* species, isolation of host plants from other patches of host plants was found to be a more important determinant of butterfly presence than host plant density (Kelly and Debinski 1998). In a study of the regal fritillary butterfly, some isolated patches totaling 13,000 individuals of violet plants (*Viola* species). were not occupied (Kelly and Debinski 1998).

After metamorphosing through five instars, a callippe silverspot butterfly larva develops into a pupa. This is the stage where the larval structures are broken down and those of the adult are formed (Opler and Krizek 1984). The condition of the host plant has an effect on whether a larva reaches the pupae stage. The pupal stage of the callippe silverspot butterfly lasts about 2 weeks (Arnold 1981), which is average for the genus *Speyeria* (Macy and Shepard 1941). Male callippe silverspot butterflies emerge from their pupa before females, a characteristic known as protandry (Nagal *et al.* 1991). Protandry is a common phenomenon among butterflies (Zonneveld 1996), and males usually eclose about a week before females (Mattoon *et al.* 1971), but this varies from season to season (Thomas Reid Associates 2002).

The flight period of the callippe silverspot butterfly ranges from 46 to 95 days. An increased death rate from adverse weather conditions or lack of nectar resources will shorten the season, and decreased death rates from favorable weather conditions or nectar availability will lengthen the flight season. The data from San Bruno Mountain show that 49 percent of the variation in flight period can be explained by the number of individuals observed. For example, for each additional 100 butterflies observed, the observed flight period will appear on average 2 days longer (Thomas Reid Associates 1985a, 1988, 1992, 1998, 2000, 2002). In mark-release-recapture studies, Arnold (1981) found the lifespan of adult butterflies to be 4.9 days for males and 7.3 days for females.

Adult callippe silverspot butterflies feed on flower nectar to acquire carbohydrates and amino acids (Arnold 1981). Nectar availability is correlated with adult longevity and egg production in females of many butterfly species (Murphy *et al.* 1983; Opler and Krizek 1984), but this relationship has not yet been investigated in the callippe silverspot butterfly. Arnold (1981) reported that callippe silverspot butterflies drink nectar from the non-native bull thistle (*Cirsium vulgare*), non-native milk thistle (*Silybum marianum*) and native golden aster (*Heterotheca villosa*) on San Bruno Mountain. Observations at San Bruno Mountain resulted in the

identification of four preferred nectar plants: non-native thistles (*Carduus* species), native Alameda County thistle (*Cirsium quercetorum*), milk thistle, and native coyote wildmint (*Monardella villosa*) (Thomas Reid Associates 1982). The preferred plant species are in flower throughout the flight season, therefore there is no shift among nectar sources (Thomas Reid Associates 1982). Secondary nectar sources include the golden aster, wild buckwheat (*Eriogonum latifolium*), mourning bride (*Scabiosa atropurpurea*), and California buckeye (*Aesculus californica*) (Thomas Reid Associates 1982). Possible nectar sources include other native plants: poppies (*Eschscholzia* species), scorpion weeds (*Phacelia* species), live forever (*Dudleya* species), and checkerblooms (*Sidalcia* species) (Thomas Reid Associates 1982). In a separate study, callippe silverspot butterflies were seen obtaining nectar from thistles, coyote wildmint. California horkelia (*Horkelia californica*), mourning bride, California buckeye, and narrow-leaf mule ears (*Wyethia angustifolia*) (Murphy and Weiss undated). Opler and Krizek (1984) found that the size of the flowers visited by adult butterflies is in direct proportion to the length of their proboscis. The blooming period, relative abundance, color, height above ground, and the shape of the inflorescences also influences which flowers are visited by the animals (Opler and Krizek 1984).

Male callippe silverspot butterflies are more likely to be observed than females. During mark-release-recapture studies at San Bruno Mountain, 68 percent of adult callippe silverspot butterflies were male (Thomas Reid Associates 1982). This phenomenon is apparently due to the males' higher levels of activity. At San Bruno Mountain, males were found resting only 36 percent of the time, versus 53 percent of the time for females (Thomas Reid Associates 1982). Notwithstanding the differences in observation and capture, the sex ratio for the subspecies is presumed to be 1:1 (Arnold 1981).

Hilltops and ridges play an important role in callippe breeding behavior and the this species has been documented to congregate on hilltops and ridgelines to find members of the opposite sex and mate, a behavior referred to as "hilltopping" (Shields 1967). Hilltopping occurs most notably when population numbers are low in number or individuals are dispersed; this behavior aids in mate location and to increase mating success. Males are more likely than females to spend time on hilltops. In a study at San Bruno Mountain, 62 percent of male callippe silverspot butterflies were caught on hilltops, while only 48 percent of females were caught on hilltops (Thomas Reid Associates 1982). After mating, females spend less time hilltopping, and more time searching for oviposition sites and nectar sources. Males tended to utilize hilltops throughout their lifespans (Thomas Reid Associates 1982). The observations at San Bruno Mountain included aggregations of butterflies around shrubs consisting of two to four males and one to two females (Thomas Reid Associates 1982). Males often conduct searching flights around shrubs (Thomas Reid Associates 1982). Males actively patrol hilltops and knolls searching for females. Females are mated almost immediately upon emergence from pupae, because males emerge first from their pupae, search for and doggedly pursue females (Mattoon *et al.* 1971). Most observations of the callippe silverspot butterfly have been made on hilltops; this is the case at the two major San Bruno Mountain colonies. At the Southeast Ridge colony, 75 percent of the observed individuals were on ridgetops and higher elevations of steep, north-facing slopes (Thomas Reid Associates 1982). The importance of hilltops may vary with population density; at high population levels, some males may patrol below hilltops, and congregate on them during periods of low population levels (Shields 1967; Baughman *et al.*

1988). However, evidence from studies of multiple butterfly species that occupy gently rolling topography indicates that hilltopping behavior can be triggered by even small variations in topography (Baughman and Murphy 1988). Hilltops and ridge lines are integral components of callippe silverspot butterfly habitat. Losing hilltops from habitat areas likely decreases the amount of successful mate location and genetic mixing over the long-term.

Paired males and females exhibit some mating flight behavior, which is characterized by a spiraling flight (Thomas Reid Associates 1982). Once paired, mating takes about 5 minutes, during which males transfer a spermatophore to the female (Thomas Reid Associates 1982). After mating, females have been observed to reject advances of other males (Thomas Reid Associates 1982). Mated females then begin to lay eggs, completing the life cycle.

Butterflies are poikilothermic and they cannot regulate their body temperatures internally (Clench 1964; Opler and Krizek 1984). In general, butterflies can not fly when air temperatures drop below 60.8 degrees Fahrenheit; air temperatures higher than 100.4 degrees Fahrenheit in combination with high humidity, are unsuitable for most species (Opler and Kriezek 1984). Butterflies use a variety of behavioral actions to raise their body temperature including changing the wing and body orientation to the sun, elevating or depressing their abdomen, perching at different heights or locations, changing the height of their flight, and moving in of out of the shade (Opler and Kriezek 1984; Kingsolver 1985). The dark coloration of the callippe silverspot butterfly may be a thermal adaptation to the fog belt surrounding the San Francisco Bay, because dark objects absorb more sunlight than light objects. Wing color and darker colors at the bases of the wings, such as that possessed by the callippe silverspot butterfly, play an important role in the efficiency of basking for thermoregulation (Kingsolver 1985). The dense hair on the thorax of the callippe silverspot butterfly also may decrease heat loss.

Butterflies in the genus *Speyeria* may be among the first animals to be eliminated as a result of human-caused activities (Hammond and McCorkle 1983). Hammond and McCorkle (1983) noted that silverspot butterflies have greatly declined in the last 200 years, and several subspecies are imperiled or extinct.

Urban development, along with invasive exotic plants, are the primary causes of the decline of the callippe silverspot butterfly because these two factors degrade, destroy, and fragment its habitat. At least five occurrences of this species have been eliminated by the conversion of natural habitat to urban development. Populations have been eliminated from San Francisco (Behr 1862; Cotte 1928). Thomas Davies (1978) formerly of the California Academy of Sciences described the extirpation of a callippe silverspot butterfly population in the East Bay:

> This species I have known since childhood and have seen it slowly and steadily disappear from its habitats in the Oakland Calif. Hills. This area [Merritt College Campus] at one time consisted of a long grassy ridge terminating on its northern end in a large quarry and a deep hole known as Devil's Punch Bowl. In 1961 and for a few subsequent years a large colony of *Speyeria c. callippe* flourished on this ridge for a distance of 1/4 mile. In the late 1960's it was proposed to use the area as a college site. The ridge was leveled and the earth bulldozed north to fill the old quarries. This work subsequently destroyed the larger portion of *Speyeria*

> *c. callippe* habitat in the area. What remains of the colony is precariously existing on the lower western slopes of the man made table land. The further enlargement of parking lots or building sites for the college will eventually destroy what is left of *Speyeria c. callippe* in the area.

In 2008, 476 adult callippe silverspot butterflies were observed on 13 set transects on San Bruno Mountain (Thomas Reid Associates 2009). The surveys were conducted from May 8, 2008, to July 9, 2008. 269 callippe silverspot butterflies, the majority of individuals observed during the surveys, were seen on the southern portion of San Bruno Mountain east of the Radio Ridge parking lot. 89 individuals were observed on the Northeast Ridge; 24 animals on the north side of Guadaupe Canyon Parkway and 65 animals on the grasslands on the south side of this road. 27 callippe silverspot butterflies were seen on the transect located in the immediate vicinity of Landmark Neighborhood II; over the field visits, this averaged out to 4.5 sightings per hour. The number of callippe silverspot butterflies does not provide the precise number of individuals in the population, but it does give relative abundance of the adult animals and their use of San Bruno Mountain by this species (Gall 1985; Pollard 1977, 1979, 1984; Pollard *et al.* 1973).

There are recent records of the callippe silverspot butterfly on San Bruno Mountain and Sign Hill (Thomas Reid Associates 2008, 2009; San Bruno Mountain Habitat Conservation Plan Steering Plan 1982; California Department of Fish and Game 2009a, 2009b; C.D. Nagano, pers. obs.). On San Bruno Mountain, there are two population centers of the callippe silverspot butterfly, but adults regularly disperse between them (Thomas Reid Associates 1982). Of the two colonies on San Bruno Mountain proper, the Southeast Ridge usually has many more individuals than Guadeloupe Hills (Thomas Reid Associates 1985a). Some adult callippe silverspot butterflies also disperse from San Bruno Mountain to Sign Hill, and vice versa.

Suitable habitat containing the larval foodplants, adult nectar sources, and hilltops are found in and adjacent to the action area. Therefore, the Service believes that the callippe silverspot butterfly occurs within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed species.

San Bruno Elfin Butterfly

The San Bruno elfin butterfly was listed as an endangered species in 1976 (Service 1976). Critical habitat was proposed (Service 1977) but was later withdrawn (Service 1978).

The adult San Bruno elfin butterfly has a wingspan of approximately 0.50 inch. The ventral sides of wings are dark, mahogany brown colored with a gray postmedian area. It can be distinguished from other elfin butterfly species by its white fringe, and the white line on the hind wing that separates the dark basal half from the hoary shading on the outer half of the wing.

Despite its occurrence in a region where entomologists had intensively collected for over a century, the San Bruno elfin butterfly was not formally described until 1962 (Brown 1962). The animal is restricted to north-facing rocky slopes containing Pacific stonecrop (*Sedum spathulifolium*), the sole foodplant of the larvae, in the fog belt in San Mateo County in

California (Arnold 1981, 198; Brown 1969a, 1969b; Emmel and Ferris 1972; Reid *et al.* 1980; Service 1984). It currently is known from San Bruno Mountain, Malagra Ridge, Sweeney Ridge, Whiting Ridge, and Montara Mountain in San Mateo County, California. All of the known populations of the animal on San Bruno Mountain are located on Radio Ridge and along the Southeast Ridge (Arnold 1978; Thomas Reid Associates 2008).

The single flight period of the San Bruno elfin butterfly extends from late February to mid-April. Hardy (1957) described the early life stages of the nominate subspecies. After mating, the females lay their eggs singly on uppersides and undersides of the leaves (Emmel and Ferris 1972) or the base of the flowers (Hardy 1957) of the larval foodplant. The egg is a pale pastel green and is about 0.75 millimeter by 0.33 millimeter in size. The larvae hatch from their eggs within 5-7 days after being laid and the first instar bore into the smaller, more succulent leaves of the rosettes to begin feeding (Emmel and Ferris 1972; Service 1984). The third instar larvae crawl up the flower stalks and feed until they mature on the flowerheads. Under field conditions, the larval stage is generally completed by late May or early June (Emmel and Ferris 1972; Service 1984). The third and fourth instar larvae of the San Bruno elfin butterfly are tended by eight species of ants (Arnold 1978; Service 1984). The mature fourth instar larvae are about a half inch long (Hardy 1957) and are red or greenish yellow and they may have whitish lateral chevrons (Ballmer and Pratt 1988). The larvae then crawl off their foodplant and pupate among plant debris (Hardy 1957; Emmel and Ferris 1972). The pupae stay dormant until the following spring, when the adults emerge (Hardy 1957). The development from egg to pupae takes about six weeks (Hardy 1957). Arnold (1978) found that the larvae of this animal may be parasitized by a tachinid fly (*Aplomya theclarum*).

The adult butterflies are fairly sedentary; males move an average of 153 feet and the females move an average of 132 feet, the maximum observed distance was 504 feet (Arnold 1978). The adult males lived an average of 7 days and the females an average of 8 days (Arnold 1983b). Arnold (1978) stated that males emerge earlier than females and he reported that butterfly collectors would wait until a week or so after the sighting of the first males to obtain perfect specimens of both male and female San Bruno elfin butterflies. Arnold (1978, 2007b) found that the animals use several species of flowering plants for nectar, but the primary sources is cow parsnip (*Lomatium utriculatum*).

Male San Bruno elfin butterflies perch on Pacific stonecrop and other plants and then dart out at passing flying objects, while the females tend to remain sedentary (Arnold 1978). The males preferred perches such as woolly sunflower (*Eriophyllum* species) and Baccharis (*Baccharis* species) which were 12-24 inches above the surface of the ground, while females preferred *Sedum* and bar ground which were from 0-6 inches above the surface.

During the 2008 survey season for the San Bruno elfin butterfly, 77 caterpillars were observed on the set transects; fixed points were monitored from 1999 to 2003, none were conducted in 2004 and 2005, and observations were made in 2006 (Thomas Reid Associates 2009). The number of larvae observed ranged from 140 in 1999 to 373 in 2006. According to Thomas Reid and Associates (2009), the Pacific stonecrop and it habitat appeared vigorous, with no visible threats. The low number of larvae observed during the monitoring was attributed to the animals emerging earlier in the season and the monitoring was, therefore, conducted too late. However,

no definitive data was present to demonstrate this hypothesis. Other factors besides habitat destruction, or late surveying may also be responsible for the lower numbers of San Bruno elfin butterfly larvae observed in 2008, including predators, such as sowbugs (*Porcellio laevis* and *Armadillidium vulgare*) and earwigs (including, but not limited to *Euborellia annulipes* and *Forficula auricularia*) are predators on eggs, larvae, and pupae of butterflies (Edney *et al.* 1974; Langston and Powell 1975; Mattoni *et al.* 2003).

There are recent records of the San Bruno elfin butterfly on Radio Ridge and other suitable habitat on San Bruno Mountain marked on Figure 8 of the San Bruno Mountain Habitat management Plan 2007 (San Mateo County Parks Department 2007). Suitable habitat containing the larval foodplants, and adult nectar sources are found in the action area. Therefore, the Service believes that the San Bruno elfin butterfly occurs within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed species.

Mission Blue Butterfly

The mission blue butterfly was listed as endangered in 1976 (Service 1976). Critical habitat was proposed in 1977 (Service 1977) but was later withdrawn (Service 1978).

This species was described by Hovanitz (1937) based on specimens collected at Twin Peaks in San Francisco. The mission blue butterfly has a wingspan of about an inch. The uppersides of the wings of the males are brilliant blue with white margins; the undersides are pale grey with two rows of irregular small white-ringed black spots. The upperside of the wings of the female are brown, usually with a flush of blue scales at the base of the forewing.

The butterfly inhabits a few sites containing grasslands in southern Marin and San Mateo counties in California that contain one or all three of its larvae foodplants (*Lupinus albifrons*, *L. formosus*, and *L. variicolor*). Williams (1908) reported that the larvae of what was apparently the mission blue butterfly "...in the region around San Francisco" fed on the miniature lupine (*Lupinus bicolor*) (=*Lupinus bicolor*). However, the observation apparently has not been repeated for this endangered animal.

Although lepidopterists have only made limited observations of the early life history stages of the mission blue butterfly, their life cycle likely is similar to other subspecies of Boisduval's blue butterfly (*Icaricia icarioides*)(R.H.T. Mattoni, pers. comm. to C.D. Nagano 1997). After they have mated, the females lay their eggs throughout their flight period. Single eggs are deposited on the leaves, stems, flowers, and seed pods of the three *Lupinus* foodplants. The eggs are green overlaid by white papillae of the chorion (Comstock and Dammers 1935). The majority of eggs are laid on new growth, primarily the upper surfaces of the leaflets (Service 1984) and they hatch in about 4-10 days (Downey 1957; Guppy and Shepard 2001; Service 1984). The mature larvae are reddish purple or green with three purple or inconspicuous diagonal white lines on each body segment and the body is covered with short white hairs (Layberry *et al.* 1998; Guppy and Shepard 2001). The first and second instar larvae feed on the mesophyll of the *Lupinus* foodplant. About three weeks after eclosion, the second instar larvae begin an obligate diapause; most diapause in the leaf litter at the base of the foodplants. The following spring, the larvae

break diapause and resume feeding. Cessation of diapause varies widely, even among sibling larvae. Under laboratory conditions, this period may be as great as one month. However, so larvae of the mission blue butterfly, as well as other subspecies of *Icaricia icarioides*, may be able to extend their diapause for more than one season, depending upon the individual and environmental conditions (R.H.T. Mattoni pers. comm. to C.D. Nagano 1997). This protracted cessation of diapause and the variation in microclimate is why newly emerged adults can be observed throughout the 8-10 week flight period. Behavioral observations of the closely related endangered Fender's blue butterfly (*Icaricia icarioides fenderi*) found the larvae are alert to potential predators, with individuals dropping from their feeding positions on lupine leaves to the base of the plant at the slightest disturbance (Service 2000). The last instar larvae of the mission blue butterfly pupate on or near the base of the *Lupinus* foodplant rather than in the ground or in ant nests as suggested by Downey (1957). The pupal stage lasts approximately three weeks (Guppy and Shepard 2001). The pupa is green, and the abdomen is green or reddish-brown with green blotches (Scott 1986; Guppy and Shepard 2001). A mission blue butterfly may complete its life cycle in one year.

The larvae of many species of lycaenid butterflies, including Boisduval's blue butterfly, possess specialized glands that secrete a sweet solution sought by some ant species who may actively "tend" and protect them from predators and parasites (Ballmer and Pratt 1988). Downey (1962a) recorded 11 species of ants that tended *Icaricia icarioides*. The mission blue butterfly is a myrmecophile because the third and fourth instar larvae have been observed to be tended by ants, primarily *Prenolepis imparis* (Service 1984; Wang 2008). Downey (1957) found that the ant *Formica lasioides* tended the mission blue butterfly on Twin Peaks. Howe (1975) stated that larvae of the mission blue butterfly may sometimes be found on leaves or in the lupine blossoms by looking for the more conspicuous ants in attendance. Ants may construct chambers at the base of the foodplants just beneath the surface of the soil for access to the resting larvae, as diurnal resting places for the larvae, or both (Howe 1975). Wang (2008) hypothesized that the presence of *Prenolepis impairis* on the Northeast Ridge was one of the reasons why this area of San Bruno Mountain is important for the mission blue butterfly, however, he presented no information supporting his belief.

In one study, 35 percent of field collected eggs of the mission blue butterfly were parasitized by an unidentified species of encyrtid wasp (Service 1984); Downey (1962b) recorded parasitoid wasps of the genus *Trichogramma,* an egg parasite, from 50% of the 53 populations that he examined of Boisduval's blue butterfly. Third and fourth instar larvae were parasitized by a tachnid fly or braconid wasp. According to Howe (1975), there is a high incidence of parasitism in mature larvae of Boisduval's blue butterfly located on the foodplants during the daytime; he stated that healthy larvae tend to be nocturnal feeders. Rodents also may prey on the early stages (Service 1984).

The species is univoltine and has a flight period that extends from late March to mid-June. This animal does not hilltop. On San Bruno Mountain, discrete populations of the animal near the mountain's peak and on the western and southern-facing slopes generally are the first to emerge each year (Service 1984). These are followed by populations on the Northeast Ridge, South Slope, and Southeast Ridge. Mission blue butterflies in Owl and Buckeye canyons are the last to

emerge, perhaps due to their northern exposure and intermittent creeks that keep these areas cooler and more moist than other areas of San Bruno Mountain.

Adult mission blue butterflies have been observed visiting a number of plants for nectar including wild buckwheat (*Eriogonum latifolium*), golden aster (*Chrysopsis villosa*), blue dicks (*Brodiaea pulchella*), and Ithuriel's spear (*Brodiadea laxa*)(Arnold 2007b).

The grassland ecosystem on San Bruno Mountain is a disclimax community. That is, maintenance and regeneration of the plants characteristic of these ecosystems are dependent upon irregular perturbation processes that preclude normal succession. The *Lupinus* foodplants are dependent upon natural disturbance processes, such as rockslides, mudslides and fires to establish their seedlings. Thus, the survival and recovery of the mission blue butterfly requires not only sufficient tracts of grassland, but also management of the disturbance factors upon which this habitat is dependent.

Public ownership of habitat does not necessarily result in the complex natural processes necessary for the maintenance of the mission blue butterfly and its habitat. One of the greatest threats to the listed butterfly is loss of habitat due to succession to control coastal scrub and invasive exotic plant species. Ecosystems are dynamic, fluctuating through time in structure, composition and areal extent. Dynamics are initiated by environmental fluctuation, natural disturbance, species senescence or other intra-community characteristics. The *Lupinus* foodplants of the mission blue butterfly are dependent upon natural perturbations to establish seedlings. Under natural conditions, adults of this endangered species are widely distributed at relatively low densities. *Lupinus albifrons*, *L. formosus*, and *L. variicolor* also are widely distributed at low densities. These three plants are "pioneer" species (i.e., they grow best in areas of recent localized disturbance or in early stages of grassland succession). Patchily distributed dense colonies of these *Lupinus* are found at sites of natural disturbance, such as rodent burrows, mudslides, rock slides, fire, etc throughout the grassland. These colonies eventually senesce as other successional plants and weeds invade these sites, unless an irregular disturbance regime occurs that allows the *Lupinus* to propagate.

Under historic conditions on San Bruno Mountain, perturbations operate, thereby allowing localized aggregations of *Lupinus* foodplants and the mission blue butterfly to become established. These colonies are of various ages. For example, at recently disturbed sites, *Lupinus* seedlings are established but there are few mission blue butterflies; dense colonies of the butterfly are located in areas where lupine patches ranging in size from 0.7 acre to 49.42 acres exist; and there are senescent *Lupinus* stands that support decreasing numbers of the listed butterfly -(Service 1984). Thus, the disturbance processes that allow for colonization of *Lupinus*, and subsequently the mission blue butterfly, are dynamic, and each colony is dynamic and relatively short-lived. The butterflies opportunistically utilize localized dense patches of *Lupinus* as long as they exist, but as these patches later decline in quality or suitability, the animals move to newly established *Lupinus* patches. The ephemeral nature of localized, high density colonies of the *Lupinus* foodplants may be an important factor in the long-term survival of the mission blue butterfly.

In 2007, 200 mission blue butterflies were observed on 14 set transects on San Bruno Mountain (Thomas Reid Associates 2008). The surveys were conducted from March 22, 2007, to May 22, 2007. 135 mission blue butterflies, the majority of individuals observed during the surveys, were seen on the South Slope and the Southeast Ridge in the southeast corner of the Mountain. 38 individuals were observed on the Northeast Ridge; 4 animals on the north side of Guadalupe Canyon Parkway and 34 animals on the grasslands on the south side of this road. 10 mission blue butterflies were seen on the transect located in the immediate vicinity of Landmark Neighborhood II; over the four field visits, 10 animals were seen during the beginning of the survey, or 3.9 sightings per hour. The number of mission blue butterflies does not provide the precise number of individuals in the population, but it does give relative abundance of the adult animals and the use of San Bruno Mountain by this species (Gall 1985; Pollard 1977, 1979, 1984; Pollard *et al.* 1973).

There are recent records of the mission blue butterfly within the area marked on Figure 5 of the San Bruno Mountain Habitat Management Plan (San Mateo County Parks Department 2007; San Bruno Mountain Habitat Conservation Plan Steering Committee 1982; Thomas Reid Associates 2007; California Department of Fish and Game 2009a, 2009b; C.D. Nagano, pers. obs).. Suitable habitat containing the larval foodplants, adult nectar sources, and hilltops are found in and adjacent to the action area. Therefore, the Service believes that the mission blue butterfly occurs within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed species.

Bay checkerspot Butterfly

The Bay checkerspot butterfly was listed as threatened on September 18, 1987 (Service 1987). Please refer to the final rule and the *Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area* (Service 1998) for additional information on this species.

Euphydryas editha bayensis is a medium-sized butterfly in the brush-footed butterfly family or Nymphalidae. It has with a wing span of approximately two inches. The predominant color of the upper wings are black checkered with red and orchreous yellow markings which stand out in striking contrast to each other. The under wings are predominantly orchreous yellow, but also with sharp patterns in black and red. The adult males and females are very similar in appearance. The egg, larva, and pupa of the endangered quino checkerspot butterfly (*Euphydryas editha quino*), a closely related subspecies in southern California have been described by Emmel and Emmel (1973).

The Bay checkerspot butterfly formerly occurred around San Francisco Bay area, from Lake Mead (Cottle 1928) and Twin Peaks in San Francisco (Reinhard undated) south to Gilroy in Santa Clara County and then north as far as Mount Diablo in Contra Costa County. Currently, habitat occurs on shallow, serpentine derived or similar soils, which support dwarf plantain (*Plantago erecta*), purple owl's-clover (*Castilleja densiflora*) or exserted paintbrush (*Castilleja exserta*), the larval food plants, as well as nectar sources for adults. Its range has been significantly reduced and the species currently occupies five sites, all occurred within an approximate nine mile radius in Santa Clara County. All areas now or recently inhabited by the

Bay checkerspot are island-like patches of suitable habitat isolated by intervening unsuitable habitat and urban development.

Euphydryas editha bayensis is univoltine, reproducing once and dying in a single year. Adults emerge from their pupae in early spring, feed on nectar, mate, and lay eggs during a flight season that lasts for 4 to 6 weeks from late February to early May. Male Bay checkerspot butterflies typically eclose 4 to 8 days earlier than females, and find and mate with most females soon after they emerge (Baughman 1991). Males are capable of mating multiple times, while most females are believed to mate only once, although they are capable of re-mating 4 to 7 days after the first copulation. Adults of both sexes have an average life span for of approximately 10 days, although some individuals are documented to have lived for over 3 weeks (Service 1998a). The Bay checkerspot butterflies is a hilltopper (Service 1998).

After mating, females lay up to five egg masses with 5 to 250 eggs in each mass. In laboratory environments, females on various diets have been documented to have lifetime production of 250 to 1,000 eggs, including about 250 to 600 lifetime eggs without food. The larvae hatch from their egg in about 10 days and grow to the fourth instar in approximately two weeks, depending on food availability. The primary host plant for the caterpillars is dwarf plantain, an annual, native plantain species. In many years, the larvae require a secondary host plant species, when the plantain senesces prior to the larvae reaching their fourth instar. Under these conditions, the larvae move to and feed on purple owl's-clover or exserted paintbrush, since these species typically remain edible later in the season than dwarf plantain (Service 1998). Eggs are typically deposited near the base of dwarf plantain, or less often, purple owl's clover or exserted paintbrush (Service 1998). Hellmann (2002) found egg masses were laid on dwarf plantain 43.1% of the time, purple owl's clover 22.2% of the time, exserted paintbrush 2.8% of the time, and on non-host plants or other substrate 31.9% of the time. Hellmann (2002) also reported that by 8 days after hatching, the proportion of larvae on dwarf plantain was equal to the number on purple owl's clover and exserted paintbrush combined. Optimal habitat contains substantial densities of dwarf plantain, and at least one of the secondary larval host plant species, and nectar plants for adults. Plant species commonly visited for nectar include lomatium (*Lomatium* species), California goldfields (*Lasthenia californica*), yarrow (*Achillea millefolium*), goldenstar (*Mullia* species), popcorn flower (*Plagiobothrys* species and *Cryptantha* species), wild onion (*Allium* species), California buckwheat (*Eriogonum fasiculatum*), and tidy-tips (*Layia platyglossa*).

Some prediapause larvae successfully reach diapause by switching to secondary host plant such as purple owl's-clover (Singer 1972) or exserted paintbrush, the secondary host plants. Since they senesce slightly later, the presence of these plants can extend the feeding season of prediapause larvae by several days, which is may allow the animals to eat enough to enter diapause. The dispersal distance of prediapause larvae might be limited and they only may be able to utilize secondary host plants which are near the primary host plant. Diapausing *Euphydryas editha* larvae have been observed curled up under rocks or sticks and enclosed in a light webbing (Service 2003). Fleishmann *et al.* (2000) hypothesized Bay checkerspots maybe facultative cannibals when edible host plants are unavailable. Singer (1972) observed that prediapause larvae can survive to a later diapause on dwarf plantain growing on soil disturbed by Botta's pocket gophers (*Thomomys bottae*). Host plants on gopher mounds stay green longer,

possibly due to greater water capacity and longer roots in the loosened soil; the relative importance of this gopher effect on Bay checkerspot populations is unknown (Service 1998a). The summer diapause ends with the onset of the following rainy season and the germination of host plants. The larvae then resume feeding, and complete their development (Singer 1972; Murphy and Weiss 1988). These larger, post-diapause larvae are quite mobile, and may crawl several yards in search of food plants or warm microclimates in which to bask or pupate; they pupate after reaching a weight of 300 to 500 milligrams (Singer 1972) and suspended themselves from vegetation a few millimeters above the ground (White 1986). The close proximity to the ground is postulated to provide thermal benefits (Service 1998). Temperature strongly influences the time between pupation to emergence, which can vary between 15 and 30 days (White 1986). There is some evidence that in very dry years, a few larvae may enter a second diapause and complete their development the second spring after hatching (White and Levin 1981; Harrison 1989; Weiss 1996).

Mortality of post-diapause larvae is lower than for prediapause larvae. Larvae that have not reached the fourth instar before the host plant senesces or is defoliated must disperse to find another plant, or die of starvation. Mortality is greatest among prediapause larvae (Fleishman *et al.* 2000), usually in excess of 90%, (Singer 1972; Ehrlich *et al.* 1975, 1980; Dobkin *et al.* 1987; Weiss *et al.* 1988) and can reach 99 % (Murphy 1988). Cushman *et al.* (1994) suggest that in 1992, the combined mortality of egg and prediapause larval stages was about 97 to 99% at Kirby Canyon in Santa Clara County; that period was considered a "good" year with above-average rainfall and increasing numbers of Bay checkerspot butterfly in this area (Weiss 1996). The mortality of post-diapause larval combined with pupal mortality has been estimated at roughly 75% (Service 1998). Mortality of pupae was estimated by White (1986) at 53 to 89%t at Edgewood and Kirby canyons over 3 years. The latter estimates may be high if the experimentally-placed pupae used by White were more exposed to predators, parasites, or weather than naturally-placed pupae. Sources of mortality for eggs, larvae or pupae identified by White (1986) include predation probably including small mammals, birds, and predatory invertebrates, inclement weather, disease, parasitism including at least one species of tachinid fly (*Siphosturmia melitaeae*) and an unidentified ichneumonid wasp, and crushing, typically by cattle. White (1986) suggested that a substantial fraction of eggs, larvae, and pupae could be lost to trampling in areas that are heavily grazed. Adults and diapausing larvae probably are not as vulnerable to trampling.

Like many other related butterflies, *Euphydryas editha* larvae can live for several years (Service 2003). One mechanism that generates longevity is repeated diapause (Singer and Ehrlich 1979), which occurs when the caterpillars emerge from diapause, feed, and then re-enter diapause, postponing development until the next year.

The topography of serpentine grassland strongly influences its ability to support the Bay checkerspot (Murphy and Weiss 1988). South-facing slopes are warmer, and thus drier, than north-facing slopes, because south-facing slopes receive more solar radiation on clear spring days than flat ground or north-facing slopes. This variation in thermal microclimate affects the timing of both butterfly and host plant development on different slopes. Larvae on warm, south-facing slopes develop faster and emerge as adults a month or more earlier than do larvae on cool north-facing slopes (Service 1998). Host plant senescence also depends on solar exposure; host

plants on south-facing slopes flower and senesce three to four weeks before those on cooler slopes.

Adult Bay checkerspot butterflies are considered to be fairly sedentary (Ehrlich *et al.* 1975; Harrison 1989), yet long-distance dispersal of the species is well documented. At Jasper Ridge, only 1.7 % of nearly 3,000 marked males and 4.8 % of 473 marked females were found to move between subpopulation areas "C," "G," and "H," which are all within 1,600 feet of one another, narrowly separated by chaparral and oak woodland (Service 1998). Within serpentine habitat at Kirby Canyon, adult movements between locations decline nearly exponentially with distance: 10% to 15% of recaptured individuals are found about 330 feet from where they were marked, 2% to 4 % at 1,600 feet, and roughly 0.5 % at distances of 3,300 feet (Weiss 1996). However, Harrison (1989) documented recolonization of habitats up to 2.8 miles from Coyote Ridge, the source population, possibly implying greater dispersal capabilities. Bay checkerspot butterfly researchers have tentatively identified a distinct flight behavior of individuals outside of appropriate habitat, or of occasional animals within habitat: they fly higher above the ground and make a beeline out of sight (Service 1998). When released outside of appropriate habitat, Harrison (1989) observed Bay checkerspot butterfly movements of 3.5 miles (1 male), 2 miles (1 female), and 18 movements of 0.3 to 0.6 mile. One marked individual flew between Edgewood Natural Preserve and Jasper Ridge, a straight line distance of 4.7 miles (Service 1998). In all dispersal observations or experiments, long-distance movements are hard to detect, and thus their frequency and importance are underestimated.

Dispersal direct of the Bay checkerspot butterfly generally was found to be random, but dispersing individuals likely were to move into habitat patches when they passed within 160 feet, and were most likely to stay when existing density was low (Harrison 1989). The research on this threatened species suggests that patches separated from a source population to hilly terrain were less likely to be colonized than patches separated by flat ground (Harrison 1989). Harrison (1989) concluded that because establishment rates were low and initial dispersal direction was random, relatively large numbers of animals must have emigrated from the source population at some time to explain the apparent long-term habitat patch colonization pattern. High emigration and habitat patch colonization rates probably only occur during rare outbreak years, when high local densities combine with favorable establishment conditions in "unoccupied" patches that do not support larvae development (Harrison 1989). Establishment of local populations of the Bay checkerspot butterfly in distant habitat patches may be achieved within a single season through dispersal of individual animals, or over several seasons through "stepping stone" habitat patch establishment events. Dispersal studies suggest that long distance movement by individuals are not common, but may be sufficient to allow for infrequent between-patch exchanges of up to 3.7 miles. Bay checkerspot butterfly restablishment patterns and models suggest that habitat patches as distant as 4.3 miles may provide sources of reestablishment for each other via stepping-stone dispersal over a 40- to 50- year period (Harrison 1989).

Studies of Bay checkerspot butterflies have described its ecology and distribution as an example of a metapopulation (Ehrlich *et al.* 1975; Harrison *et al.* 1988). A metapopulation is a group of spatially separated populations that can occasionally exchange dispersing individuals. Because the species occurs as metapopulation, the exact distribution of the Bay checkerspot butterfly varies through time, with sites that are unoccupied one year being occupied the following, and

vice versa (Wilcox and Murphy 1985, Harrison *et al.* 1988). Since diapausing larvae are essentially undetectable in practical surveys, larvae that diapause for more than one year may be responsible for pseudo-extinctions (Service 1998a). Because of pseudo-extinction and metapopulation dynamics, even sites that apparently lack the Bay checkerspot butterfly in some years can be important to the species' survival and recovery.

Single locations with suitable habitat alone generally are not sufficient to ensure the long-term persistence of a Bay checkerspot butterfly metapopulation (e.g., Hanski 1999). A local population may be expected to persist on the time scale of years. Persistence for longer terms (e.g. decades) derives from the interaction between sets of local populations at larger geographic scales. These sets of populations are known as metapopulations. For the Bay checkerspot butterfly, a metapopulation was described as set of populations that are interdependent over ecological time. Although member populations may change in size independently, their probabilities of existing at a given time are not independent of one another because they are linked by processes of extirpation and mutual colonization, process that may occur on the order of every 10 to 100 generations (Harrison 1989).

The species' Recovery Plan (Service 1998) identifies five known core areas of habitat, four of which occur in Santa Clara County (Kirby, Metcalf, San Felipe and Silver Creek) and the fifth on the San Francisco peninsula in San Mateo County (Edgewood County Park). The fifth core area currently is extirpated. Core areas are moderate to large areas of suitable habitat that support persistent Bay checkerspot populations. The pattern of occupancy by the Bay checkerspot butterfly suggests that core populations provide migrants to colonize unoccupied habit at (Harrison *et al.* 1988). The Santa Clara County core areas all occur along a ridgeline east of the Santa Clara Valley between the cities of San Jose and Morgan Hill. In the past the ridgeline has been referred to by a number of names such as Morgan Hill, Kirby Canyon, East Hills, East Coyote Foothills, and Coyote Ridge. The Recovery Plan identifies this ridgeline as Coyote Ridge. Coyote Ridge is mostly in private ownership, and largely used as grazing land. The Santa Teresa Hills, adjacent to the Coyote Valley to the west, are considered a potential core area because of extensive suitable soils, proximity to other core areas, as well as having known occurrences of the Bay checkerspot butterfly. The species was unsuccessfully reintroduced to Edgewood County Park in 2007. Core areas and potential core areas and nearby connecting habitats have been designated as critical habitat for the Bay checkerspot. The pattern of site occupancy by the animal suggests that core populations provide migrants that colonize unoccupied habitat. Extirpation in secondary and tertiary areas is common and colonization and extirpation in these areas may occur more than once over a period of several drought cycles (Harrison *et al.* 1988).

Habitat fragmentation has been a factor in the degradation of Bay checkerspot butterfly habitat (Murphy and Weiss 1988). Over the past several years, four patches of serpentine habitat in San Mateo County have been fragmented into 11 separate pieces. Given the fact that adult Bay checkerspot butterflies tend to be sedentary (Ehrlich 1965), and that some of these fragments are separated by a State Route 280, a multi-lane highway, the potential is greatly redcuced for a declining patch to be naturally supplemented or recolonized from an extant population. In addition to the loss of habitat area that accompanies it, habitat fragmentation increases external threats by bringing sources of disturbance closer and increasing the amount of habitat near edges.

Managing the conservation of many small, discontinuous habitats also presents considerable biological and operational difficulties.

Habitat loss has reduced the number and the size of extant populations of the Bay checkerspot butterfly as well as the distance between many of them. Smaller populations are more vulnerable to extirpation due to naturally occurring events such as drought. Further, habitat reduction lowers overall habitat quality by reducing the diversity of microclimates and food plants available to larvae and adults. Destroying serpentine habitats or reducing them to non-viable sizes or condition has also eliminated stepping-stone habitats and increased the average distance between populations and habitat patches, making recolonization more difficult.

Overgrazing by livestock may result in a reduction of the larval host and adult nectar plans, sustainable grazing practices appear to be compatible with the maintenance of the habitat for the Bay checkerspot butterfly. In fact, correct levels and amounts of livestock grazing has become the predominate method of restoring and maintaining habitat (Thomas Reid Associates and Murphy 1987, Murphy 1988, Weiss 1996).

Ehrlich and Murphy (1987) reported that foot-traffic associated with intensive study of one Jasper Ridge population had a significant impact on the areas vegetation, and suggested that butterfly eggs, larvae, and pupae also may have been destroyed by the trampling. Orive and Baughman (1989) studied the effects of a mark-and-recapture study on the Bay checkerspot butterfly on Jasper Ridge, and found that handling by experienced researchers did not significantly increase observable wing-wear.

Entomologists have documented the extirpation of *Euphydryas editha* populations associated with unusual climatic events (Singer and Ehrlich 1979; Ehrlich *et al.* 1980; Singer and Thomas 1996). For example, the severe drought in northern California from 1975 through 1977 caused the apparent extirpation of 24 percent of surveyed populations of this species (Singer and Ehrlich 1979; Ehrlich *et al.* 1980). Observations and experiments suggest that the relationship between weather and survival of *Eurphydryas editha* is meduiated by the timing of its life cycle relative to that of its host and nectar plants (Singer 1972; Ehrlich *et al.* 1975; Boughton 2000). In a study conducted in 1983, unusually cold temperatures combined with wet conditions were a major mortality factor for pupae placed in the field (White 1986). Mortality during the pupae stage was high and variable enough to affect adult numbers and population dynamics (53 to 89 percent; White 1986).

Phenological mismatches have been observed in southern California with the quino checkerspot butterfly on several occasions when first instar larvae were found on foodplants that were already dying, making it unlikely that they would support the larvae to diapause (Service 2005). In general, weather conditions that hasten completion of a plant's life cycle relative to that of the butterfly, such as warm cloudy weather, cause larvae mortality (Singer 1983; Boughton 1999). Conversely, conditions that slow the completion of a plant's life cycle relative to that of a butterfly can increase the larvae survival. Microtopographic heterogeneity and associated microclimate heterogeneity, on a scale that allows larvae and ovipositing adults to select among sites, should help prolong occupancy of habitat patches (Singer 1972; Singer and Ehrlich 1979; Weiss *et al.* 1987, 1988).

The Bay checkerspot butterfly likely is sensitive to Global Climate Change, in part, because its life cycle is completely dependent on the development of its host plants, and host plant development is dependent on climate (Murphy and Weiss 1992). Using historical records and field surveys, Parmesan (1996) compared the distribution of *Euphydryas editha* in the early part of the 20th Century to their distribution from 1994 to 1996. She found that the southernmost populations of this species had the greatest number of disappearances, 80 percent of previously known populations, while northernmost populations had the lowest, fewer than 20 percent. This skewed detection pattern indicates contraction of the southern boundary of the species' distribution by almost 100 miles, and a shifting of the mean location of *Euphydryas editha* populations northward by 57 miles; closely matching recent shifts in mean yearly temperature (Parmesan 1996). An explanation for the apparent pattern is that climate trends contributed to increased prediapause larvae death due to early host plant aging at the southern range edge. Paremsan's (1996) observations suggest that the Bay checkerspot butterfly may be at risk from the effects of ongoing regional warming and drying.

San Bruno Mountain was inhabited by the Bay checkerspot butterfly until it was extirpated by a combination of overcollecting in the early 1980s and a wildfire in 1986. Suitable habitat containing the larval foodplants and adult nectar sources are found within the action area. However, it is possible that the animal will either naturally recolonize San Bruno Mountain from populations further to the south, especially in years of high abundance, or it may be reintroduced.

Bay checkerspot Butterfly Critical Habitat

Critical habitat was proposed for the Bay checkerspot butterfly on October 16, 2000 (Service 2000). The final rule designating critical habitat for this animal in approximately 23,903 acres of critical habitat for the Bay checkerspot butterfly in San Mateo and Santa Clara Counties, California was issued on April 30, 2001 (Service 2001). On March 30, 2005, the Home Builders Association of Northern California filed suit against the Service challenging critical habitat for the Bay checkerspot butterfly and other species (*Home Builders Association of Northern California v. U.S. Fish and Wildlife Service* cv-01363-LKK-JFM.). On February 24, 2006, a settlement agreement was reached that requires the Service to reevaluate the final critical habitat rule in light of the standards for designating critical habitat set forth in *Home Builders Association of Northern California v. U.S. Fish and Wildlife Service* (268 F. Supp. 2d 1197, E.D. Cal 2002) and any applicable law. In addition, the settlement stipulated that a revised proposed rule be submitted for publication on or before August 14, 2007, and a final revised rule be submitted for publication on or before August 14, 2008. On August 22, 2007, we published a revised proposed rule to designate approximately 19,746 acres in San Mateo and Santa Clara counties (Service 2007).

To be included in a critical habitat designation, the habitat must first be "essential to the conservation of the species." Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species (i.e., areas on which are found the primary constituent elements, as defined at 50 CFR § 424.12(b)). In accordance with section 3(5)(A)(i) of the Act and regulations at 50 CFR § 424.12(b), in determining which areas to designate as critical habitat, we must consider those physical and biological features (primary constituent elements) essential to the conservation of

the species and that may require special management considerations and protection. These include, but are not limited to, space for individual and population growth and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The primary constituent elements of the critical habitat for the Bay checkerspot butterfly are those habitat components that are essential for the primary biological needs of foraging, sheltering, breeding, maturation, and dispersal. The areas designated as critical habitat provide some or all of the known primary constituent elements for the listed animal, which include grassland, stands of dwarf plantain, purple owl's-clover, exserted paintbrush, spring flowers providing nectar; pollinators of the Bay checkerspot's food and nectar plants; soils derived from serpentinic rock; and space for dispersal between habitable areas. In addition, the following are each primary constituent elements to be conserved when present in combination with one or more of the primary constituent elements above: areas of open grassland, topography with varied slopes and aspects providing surface conditions with warm and moderate to cool temperatures during sunny spring days, stable holes or cracks in the soil and surface rocks or rock outcrops, and wetlands providing moisture during times of spring drought.

Appropriate grassland vegetation provides cover for larvae, pupae and adults, egg-laying stimuli and sites for females, and adequate open ground for larvae to be able to crawl efficiently in search of foraging, basking, diapause, or pupation sites (Service 1998). Stands of the food plant, including nectar plants, are important in the Bay checkerspot butterfly's life cycle.

Adequate native pollinators to sustain populations of the secondary foodplants and nectar species, including, but not limited to, such groups as bumblebees and solitary bees, are important to the value of critical habitat because these plants are dependent on pollinators to reproduce and perpetuate their populations in the area. Dwarf plantain is thought to be self-pollinating.

The San Bruno Mountain Unit is located within the proposed action area. This unit is approximately 775 acres in size, and it is primarily within San Bruno Mountain State and County Park, , while the rest of the unit is privately owned, and it is entirely within the boundaries of the San Bruno Mountain Habitat Conservation Plan. This unit contains all the features essential for the conservation of the species. However, the Bay checkerspot butterfly has not been observed in this unit since a collector captured large numbers of animals in the early 1980s and a wildfire occurred in 1986. San Bruno Mountain is a supporting element of the San Mateo metapopulation because it represents the largest area of contiguous native grassland habitat that can support the animal's host and nectar plants within San Mateo County.. The distance between this critical habitat unit and the most proximate critical habitat unit is greater than the known dispersal distance of the Bay checkerspot butterfly; however, numerous small patches of intervening grasslands may serve as additional stepping stones to potentially allow for movement between these two units.

San Francisco Garter Snake

The San Francisco garter snake was listed as an endangered species in 1967 (Service 1967) and was listed as endangered and a Fully Protected Species by the State of California in 1971. A detailed species account can be found in the *San Francisco Garter Snake Recovery Plan* (Service 1985) and the five year status review for this animal (Service 2006). Critical habitat has not been proposed or designated for the species.

The San Francisco garter snake is a slender, extremely colorful reptile, with a burnt orange head, greenish-yellow dorsal stripe edged in black, bordered by a red stripe, which may be continuous or broken with black blotches, and then a black stripe. The belly color varies from greenish-blue to blue. The eyes are relatively large, and usually seven upper and ten lower labial scales are present. The body scales are in 19 rows and the dorsal scales are weakly to strongly keeled (California Department of Fish and Game 1980; Fox 1951). Large adults can reach 36 inches or more in length. Females give live birth from June through September, with litters averaging 16 newborns (Stebbins 1985). The snakes are extremely shy, difficult to locate and capture, and quick to flee to water or cover when disturbed.

The historic range of the San Francisco garter snake extended from just north of the San Francisco-San Mateo County line near Merced Lake south along the base of the Santa Cruz Mountains to Waddell Creek (Service 1985). Within this area, the reptile's populations may have principally occupied the Buri Buri Ridge along the San Andres Rift and south in an arc from the San Gregorio-Pescadero highlands west to Tunitas Creek. From here, populations extended along the west coastline of the Peninsula to Ano Nuevo State Reserve, which is the southernmost location of the species' historic range. Currently, the species has been reduced to seven major populations in San Mateo County and northern Santa Cruz County.

The two significant components of San Francisco garter snake habitat are: 1) wetlands that support the California red-legged frog and Pacific tree frog (*Pseudacris regilla*), and 2) the surrounding upland that support mammals such as Botta's pocket gopher (*Thomys bottae*) and California vole (*Microtus californicus*), whose burrows are utilized by the reptile. The preferred habitat of the endangered serpent is vegetated ponds with an open water component near open hillsides where they can sun themselves, feed, and find cover in rodent burrows (Larsen 1994).

However, considerably less ideal habitats can be occupied by the snakes, such as ditches and waterways in the City of Half Moon Bay (McGinnis 1988). The animals also utilize temporary ponds and other seasonal freshwater bodies. They avoid brackish marsh areas because their preferred prey, California red-legged frogs and Pacific tree frogs, cannot survive in saline water. Emergent and bankside vegetation such as cattails (*Typha* species), bulrushes (*Scirpus* species), and spike rushes (*Juncus* species and *Eleocharis* species) apparently are preferred and used for cover. However, in the absence of these species, dense stands of coyote bush (*Baccharis pilularis*) or *Rubus* species may substitute as adequate cover (Barry 1994). The interface between stream and pond habitats and grasslands or bank sides is used for basking; while nearby dense vegetation or water often provide escape cover. Barry (1994) noted that scattered, as opposed to dense brush was preferred basking habitat for San Francisco garter snakes. The snakes also use floating algal or rush mats, if available.

Sag ponds, small seasonal freshwater ponds formed along the San Andreas rift, historically supported this snake, but all but one of these habitats have been destroyed by urbanization and high intensity agriculture (Barry 1994). Barry (1994) reported that the San Francisco garter snake was abundant in the sag ponds that were eliminated by the construction of Skyline Boulevard. Additional loss of suitable habitat has occurred due to the reduction in recent years of traditional ranching operations (San Mateo County Department of Agriculture 2004), resulting in seral succession of grasslands and leading to the loss of breeding and hibernation habitat for San Francisco garter snakes (Service 2006). With the loss of ecological disturbance that livestock grazing provides, upland areas become less suitable for burrowing mammals, thereby reducing the quality of these areas for the listed reptile. Additionally, declines in livestock production may lead to the elimination of stock ponds, either through intentional filling or natural siltation through lack of maintenance.

The California red-legged frog and Pacific tree frog are known to be key components in the diet of San Francisco garter snake, however, Barry (*in litt.* 2006c) noted that American bullfrogs (*Rana catesbeiana*) also may serve as prey. American bullfrogs are habitat generalists and can survive in areas that have been degraded by humans or other disturbance. This exotic ranid may facilitate the recolonization or persistence of the San Francisco garter snake in areas that are not inhabited by California red-legged frogs and Pacific tree frogs. However, some research has found that although mature snakes may prey on bullfrogs in a captive setting, they often immediately regurgitate the amphibian (Larsen 1994). The San Francisco garter snake may not be able to properly digest bullfrogs, which would preclude its suitability as a prey item for them in the wild (Larsen 1994). Adult bullfrogs likely prey on smaller garter snakes, and may be a contributing factor in their decline (Service 2006). Some biologists question the level of adverse effect caused by this predation (Barry 2005). San Francisco garter snakes are one of the few animals able to eat the toxic California newt (*Taricha torosa*) without suffering serious side effects. Although primarily diurnal, captive individuals housed in an outside enclosure were observed foraging after dark on warm evenings (Service 2006).

Female San Francisco garter snakes exhibit a high level of site fidelity (McGinnis 1989, McGinnis *et al.* 1987), particularly the burrow they use for aestivation and hibernation. Females can be found daily at the entrance to their burrow, and travel to the wetland one to two times per day (Paul Keel, pers. comm.) The aestivation burrow is also where females are encountered emerging from hibernation. The mean distance of female from her hibernacula to the Visitor Center Pond at Año Nuevo was 459 feet, with a maximum distance of 637 feet. Distances of greater than 637 feet have been reported, including an unconfirmed distance of approximately 1000 feet. Though there are periods of time when a female will not be found at the burrow, such as during Pacific treefrog metamorphosis and dispersal, the majority of females are found in the vicinity of the burrow in consecutive survey years (McGinnis *et al.* 1989).

Barry (1994) reported that the San Francisco garter snake apparently was abundant in the sag ponds that existed where Skyline Boulevard was constructed. Sag ponds were waterbodies that resulted where fault activity had impounded springflow or runoff in enclosed depressions. Barry (1994) reported that in 1966 "dozens" of San Francisco garter snakes were transplanted from these soon to be destroyed sag ponds to Point Reyes National Seashore in Marin County, and unrecorded locations in San Mateo County.

During the early 1970s, various naturalists reported the San Francisco garter snake from San Bruno Mountain. According to Barry (1994), the animals were observed on the slope north of the junction of Guadalupe Canyon Parkway and Radio Road in mixed scrub and grassland at the head of Colma Canyon. A large (780 millimeter snout- vent length) female was captured twice in September 1972 by Barry (1994). The two captures likely represent the same individual animal (Barry 1994, pers. comm.); he did not locate additional San Francisco garter snakes on subsequent visits by (Barry, pers. comm.) The female found in 1972 may have been the result of the introductions from the former sag ponds (Barry 1994, pers. comm.).

The current status of the San Francisco garter snake on San Bruno Mountain is unknown. The San Bruno Mountain Habitat Conservation Plan (San Bruno Mountain Habitat Conservation Steering Committee 1982) and McClintock *et al.* (1990) reported the Levinson parcel (Administrative Parcel 1-04), as known as PG&E Marsh, and the Saddle (Administrative Parcel 4-04) contain freshwater marsh habitat, areas that may be suitable for this endangered species. Although the snake has not been observed since 1972 (Barry 1994; Sean Barry, pers. comm. June 2005), there have not been surveys conducted for the listed reptile since the early 1970's. Barry (pers. comm.) noted that extremely low-density populations of this animal may persist in extremely small areas. Therefore, given the biology and ecology of this species, the presence of suitable habitat, the historical records, and the lack of recent surveys by qualified herpetologists, the Service believes it is possible the San Francisco garter snake currently inhabits the action area.

San Francisco Lessingia

The San Francisco lessingia was listed as endangered in 1997 (Service 1997). A detailed account of the taxonomy, ecology, and biology of this listed plant is included in the *Draft Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula* (Service 2001a).

The San Francisco lessingia is found on sandy substrates on the San Francisco peninsula and it currently is known from one population at Hillside Park in Daly City, six sites at the Presidio, and one site on San Bruno Mountain. In the 19th Century, this endangered plant was reported or collected from numerous unspecified localities and two specific areas in San Francisco: one in the northwest, from the Presidio near Lobos Creek to Lone Mountain, and one in the southwest, near Lake Merced (Brandegee 1892). Herbarium sheets with specific collection localities made during the 19th and 20th centuries clearly indicate that the historic distribution of this endangered plant was considerably wider than today.

This endangered species is an annual herb in the aster family or Asteraceae. Seedlings and young vegetative plants develop from unbranched rosettes with leaves that are spear-shaped but tapered at base, wide and rounded at tip. Mature plant heights can range from less than 2 inches in stunted plants to 1.2 feet tall. Mature stems are reddish brown and have loose grayish woolly hairs. Leaves on mature stems are small, 0.2 to 1.2 inches, most less than 0.3 inch, pinnately lobed (branching from a single central vein), toothed or entire (lacking teeth and lobes), oblanceolate or long-tapered obovate (egg-shaped, but widest at the far end), and grayish-green due to dense woolly hairs. Flowerheads appear in late summer through fall, and occur singly or

in loose clusters at the ends of stems. Depending on plant size, individuals may bear a few to hundreds of flowerheads.

Seedlings emerge from late fall to spring, soon after periods of rainfall and increased near-surface sand moisture (Pogge 1998; Service 2001a). There are two marked growth phases in development (Howell 1929). During the rainy season, seedlings develop into juveniles which develop as unbranched vegetative short plants, typically basal rosettes (relatively broad leaves on short erect stems with the growing tip near the ground). Around the end of the rainy season (mid- to late spring) the erect central shoot of the juvenile plants elongates, then branches profusely, producing smaller leaves. The plant develops a low, spreading, bushy growth habit in open conditions before it enters reproductive phase (Howell 1929; Pogge 1998). Branching continues repeatedly after flowering and seed set. Lateral shoots develop below individual flowerheads and seedheads, terminating in new clusters of flowerheads, which in turn develop more lateral shoots below them.

Flowerheads begin to form as early as May; unopened flowerheads are common in early summer. Flowers usually open beginning mid- to late summer, with abundant flowering in August-September, continuing through November (Howell 1929; Pogge 1998). Large plants in sparsely vegetated areas may produce many hundreds of flowerheads, each bearing up to 40 florets (Hickman 1993), but actual average number of seeds per flower head is about 26 (Pogge 1998), implying that the largest individuals may produce up to 36,400 seeds. Individuals competing with dense non-native annual grasses may be very short and sparsely branched, with few or tens of flowerheads.

Pollination may be achieved by insects, or possibly by wind as well (Spence 1964). Pollen of species in the genus *Lessingia* is light and dry (Spence 1964) rather than heavy and sticky, as would be expected for flowers exclusively adapted to insect pollination (Faegri and van der Pijl 1979; Proctor *et al.* 1996). Some wind-pollinated grassland species are also pollinated by insects (Faegri and van der Pijl 1979). Krombein *et al.* (1979) listed a number of native bees that have been observed pollinating the San Francisco lessignia, including *Andrena baeriae*, *Hoplitis producta gracilis*, *Ashmeadiella californica californica*, *Exomalopsis nitens*, and *Anthophora urbana urbana*. However, Spence (1964) failed to detect any indication of pollen transfer by insects in any wild populations of *Lessingia*, even though potential pollinators such as syrphid flies were present. Other potential insect pollinators observed visiting *Lessingia germanorum* flowers include numerous moths and butterflies, such as pyralid moths, skippers, ringlet butterflies, cabbage white butterflies (*Pieris rapae*), blue and hairstreak butterflies, and American lady butterflies (*Vanessa virginiensis*); flies; bees and wasps, including sphecid wasps, halictid bees, andrenid bees, bumblebees (*Bombus vosnesenskii*); mirid bugs; and weevils (A. Whelchel unpublished data 1998).

Ripe achenes (plumed "seeds") begin to disperse in September, and continue through late fall. Earliest achenes have been observed in late June (Pogge 1998). Achenes are primarily wind-dispersed, as indicated by their light weight, small size, and well-developed pappus (Spence 1964). Seed set of populations at the Presidio appears to be consistently high (Service 2001a). Seed dispersal distance has not been studied, but seedling distribution tends to be contagious around parent plants. Landscape barriers to dispersal, such as tree plantations, may be more

significant barriers to dispersal than inherent dispersal ability of achenes. Seeds may also possibly be passively dispersed by humans, by adherence of seed to footwear or clothing (Service 2001a). While dispersal ability of the San Francisco lessingia may be low because of landscape and habitat constraints, its colonizing ability in suitable open or disturbed sandy vegetation gaps at sites such as Hillside Park, Lobos Dunes, and Wherry Dunes, appears to be quite strong. At the Presidio, each population is located from a few hundred to few thousand feet from the nearest neighboring population.

Habitat loss and adverse alteration of ecological processes are the principal causes of decline of the San Francisco lessingia. The resulting small numbers and localized distribution of the species have in themselves become a primary threat to survival because of the amplified risk of extinction through random catastrophic events or progressive vegetation change. The essential ecological processes which have been lost in San Francisco dune vegetation are unimpeded transport of sand from beaches and mobile dune complexes, and natural disturbances at both large and small scales that controlled vegetation gap dynamics. Other essential ecological and geomorphic properties of the San Francisco dune system which have been lost or diminished significantly include variation in dune topography that controls windflow patterns and intensity (Olson 1958); burial and rejuvenation of stabilized dunes and dune slacks (wet depressions) by mobile dunes; wind erosion and sand transport in dune blowouts; and sand slope adjustment in eroding dune scarps (Jungerius *et al.* 1981; Carter 1988; Gares and Nordstrom 1990; Fraser *et al.* 1998).

The secondary cause of decline, and the most important short-term threat to survival of San Francisco lessingia, is habitat change caused mainly by the spread of invasive non-native vegetation, but also by excessive density and cover of native woody shrub species, especially in sheltered conditions such as planted groves of evergreen trees. The principal non-native invasive plants in older, stabilized San Francisco dunes are iceplant, and annual Mediterranean grasses, in particular ripgut brome. Other species which are locally aggressive and colonial invaders of stable dunes and sandy urban soils include an annual iceplant (*Conicosia pugioniformis*), Bermuda-sorrel, and a relatively recently established South African grass (*Ehrharta erecta*). Species like iceplant and ripgut brome tend to produce continuous, dense stands which lack vegetation gaps, and accumulate surface plant litter and soil organic matter. These conditions apparently discourage regeneration of San Francisco lessingia. Introduced trees from plantings in former dunes such as Monterey cypress; Monterey pine; and blue gum also spread spontaneously into dune scrub over time, and may convert dune scrub remnants to non-native forests.

The San Francisco lessingia recently has been documented on Reservoir Hill, Parcel 4-01-03, just north of Kennedy School (San Mateo County Parks Department 2007; Thomas Reid Associates 2007; California Department of Fish and Game 2009a, 2009b). Therefore, the Service believes that this endangered plant occurs within the action area because of the biology and ecology of the species, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed taxa.

The Threat of Native and Exotic Species of Invasive Plants to the Mission Blue Butterfly, Callippe Silverspot Butterfly, Bay checkerspot Butterfly, and San Bruno Elfin Butterfly at San Bruno Mountain

Non-native grasses and forbs that have invaded California grasslands and the conversion to coastal scrub are serious threats to the four listed butterflies due to their ability to become more abundant while outcompeting or becoming more abundant than the larvae foodplant and nectar plants. European annual grasses and forbs have displaced native forbs in California native grasslands, and in turn, have contributed to the decline of the callippe silverspot butterfly and mission blue butterfly (Biswell 1956; Murphy and Ehrlich 1989). This invasion was facilitated by widespread and intensive grazing (Fleischner 1994). Some of the exotic grasses and forbs that have invaded grasslands of the San Francisco Bay area are Italian ryegrass (*Lolium multiflorum*), slender oats (*Avena barbata*), ripgut (*Bromus diandrus*), red brome (*B. madritensis rubens*), softchess (*B. hordaceus and B. mollis*), Italian thistle (*Carduus pycnocephalus*), yellow star thistle (*Centaurea solstitialis*), bull thistle, ehrharta (*Ehrharta erecta*), filaree (*Erodium* species), cat's ears (*Hypochaeris radicata*), burclover (*Medicago polymorpha*), yellow oxalis (*Oxalis pes-caprae*), English plantain (*Plantago lanceolata*), sheep sorrel (*Rumex acetosella*), blessed milk thistle (*Silybum marianum*), and mustards (*Brassica* species and *Sisymbrium* species) (Amme 2002). Thatch produced as a result of the build up of dead exotic plants may eliminate or prevent native plant species from growing in an area, and invasive species may adversely alter soil chemistry and structure. Although many exotic forbs are used by callippe silverspot butterfly and mission blue butterfly as nectar sources, they outcompete and replace native nectar plants, and their larval foodplants. Some California grasslands revert to coastal scrub in the absence of a mechanism to prevent it. Fire and grazing may reverse coastal scrub invasion. In some instances soil conditions, such as serpentine soils, prevent plant invasion (Huenneke *et al.* 1990).

The serpentine habitat of the Bay checkerspot butterfly is not immune to invasion by non-native plants. Non-native grasses in the Silver Creek Hills choke out the host plants of the Bay checkerspot butterfly (Service 1998), and yellow star thistle has invaded some serpentine areas of Edgewood County Park. Certain eucalyptus species grow in serpentine, and destroy butterfly habitat through shading and the essential oils in their leaf litter. New invasive plants continue to be introduced to northern California through gardens, landscaping, and accidental means. The few existing experimental on dwarf plantain have been carried out on serpentine grassland in northern California. After early fall rains, dwarf plantain germinated later than soft chess, a nonnative grass (Gulmon 1992). Similarly, dwarf plantain decreased during years of high rainfall, correlated with high productivity of soft chess (Hobbs and Mooney 1991). Soft chess was more competitive that dwarf plantain in greenhouse experiments, and nitrogen fertilization decreased the size and density of *Plantago erecta* (Koide *et al.* 1987). These studies indicate that weed competition will reduce the occurrence of dwarf plantain in exotic annual grassland.

Soil fertility may influence nonnative plant invasion, as invasive species often are better competitors for soil nutrients than native species (Allen *et al.* 1998). Soils in urbanized and agricultural reqions are being fertilized by excess nitrogen generated by human activities. Burning of fossil fuels, production of fertilizer, and cultivation of nitrogen-fixing crops now add as much nitrogen to global terrestrial ecosystems as do all natural process combined (Vitousek *et al.* 1997). In addition, nitrogen deposition, associated with urbanization and vehicular traffic, can degrade the grassland habitats of the Bay checkerspot butterfly by fertilizing otherwise infertile serpentine soils, stimulating the growth of invasive non-native plants (Weiss 1999; Huenneke *et*

al. 1990; Service 1998). With such fertilization, taller or more aggressive non-native vegetation may crowd out the larvae food plants.

Native and exotic plant invasion may change the behavior of the callippe silverspot butterfly, mission blue butterfly, San Bruno elfin butterfly, and the Bay checkerspot butterfly by the modification of fundamental aspects of grassland habitat. The invasion and dominance by these plants likely changes the structure of the low-lying grassland which is detrimental to the four listed animals who utilize open habitat. Butterfly species may be sensitive to changes in habitat structure such as edges of grasslands (Reis and Debinski 2001; Schultz and Crone 2001), hilltops (Shields (1967; Lederhouse 1982); forest edges (DeVries et al. 1999; Haddad 1999); perches taller than the surrounding habitat (Rutowski 2000); and microtopographic changes that provide protection from wind and access to basking spots (Thomas *et al.* 1986). These effects may affect or alter reproductive related behaviors such as mate searching, territorial defense, predator avoidance, oviposition and nectaring (Clench 1966; Heinrich 1986; Shreeve 1986; Stutt and Wilmer 1998; Ide 2002; Bewaerts and Van Dyck 2004). The larvae foodplants may be reduced in abundance and/physical size (Wiklund 1984; Krban 1997; Floater and Zalucki 2000), or oviposition may decline if the taller plant species alter the preferred egg-laying environment (Williams 1981; Thomas *et al.* 1986).

Grassland quality and butterfly diversity may be related to each other, because floristically degraded grasslands tend to be less diverse and contain lower relative butterfly diversity than undisturbed native grassland (Pollard *et al.* 1998; Maes and Van Dyck 2001; Collinge *et al.* 2003). Although a lack of floral diversity is often assumed to be the link between grassland degradation and low butterfly diversity, changes in vegetative structure have been linked with population decline and extinction of grassland butterflies. Due to an increase in the overall sward height with respective to the native condition, the silver spotted skipper (*Hesperia comma*)(Thomas *et al.* 1986; Thomas and Jones 1993) and the Adonis blue butterfly (*Polyommatus bellargus*) declined in abundance due to decreased larvae survival and a lack of suitable oviposition sites. Locations inhabited by populations of the Bay checkerspot butterfly have been invaded by exotic grasses and herbaceous plants, which resulted in the loss of larvae foodplants and nectar sources and subsequent extirpation (Weiss 1999). Dominance of grassland by invasive native and exotic plants that increase the sward height may alter the behavior of some butterfly species, especially when the larvae foodplants and nectar plants are visually obscured by taller vegetation.

In grasslands dominated by tall grass species, some butterfly species drop their eggs while in flight or after alighting on the ground if the larvae foodplant is physically obscured or has senesced, resulting in the larvae having to search for their foodplant (Scott 1986; Kopper *et al.* 2000). However, in grasslands that are naturally dominated by shorter grass species and larvae foodplants are conspicuous, shading and visual obstruction of the foodplants by taller invasive native and exotic plants may significantly alter butterfly behavior related to survival and reproduction, particularly in animals that directly oviposit on their foodplant. The invasion and dominance of taller grass species resulted in the loss of the larvae foodplants of the Bay checkerspot butterfly (Weiss 1999), while, in the case of the endangered Fender's blue butterfly, a subspecies closely related to the mission blue butterfly, the larvae foodplants were still present, but not as effectively detected by ovipositing females (Severns 2009).

Grassland conversion caused by the invasion of invasive non-native plants is perhaps the most significant and imminent threat to the callippe silverspot butterfly population on San Bruno Mountain. A number of shrub species also have invaded grassland habitats at San Bruno Mountain over the past 40 years. These include gorse, various brooms, and even native shrubs. For example, gorse increased in acreage 140 percent from 1972 to 1986 on San Bruno Mountain (Thomas Reid Associates 1987). Shrubs shade out native grassland forbs and grasses, including Johnny jump up.

Based on the data collected on the mission blue butterfly and the callippe silverspot butterfly on San Bruno Mountain which was collected from 1982 to 2000, the distribution of these two species within the areas surveyed was stable (Longcore *et al.* 2004). However, Longcore *et al.* (2004) found that the occupancy within certain cells or specific areas showed negative trends. The amount of grasslands within the conserved habitat on San Bruno Mountain decreased by an estimated 122 acres or 8.6% between 1982 and 2004 (Thomas Reid Associates 2007). Core habitat for endangered species on San Bruno Mountain has been protected from invasive plant species over the span of the San Bruno Mountain Habitat Conservation Plan. But the success of these efforts has been attenuated by landscape changes that are the result of the expansion of coastal scrub into grasslands, especially on north-facing slopes; and the influx and expansion of herbaceous and invasive exotics weeds within the native grasslands, especially on drier and lower elevation slopes.

The San Bruno Mountain Habitat Conservation Plan identified the need to control the expansion of invasive exotic and native plant species because it was written with the recognition that this threat was occurring at a high rate. There was a significant expansion of coastal scrub and the resulting loss of grassland, approximately 541 acres, on San Bruno Mountain between 1932 and 1981. Gorse expanded by 282 acres and blue gum eucalyptus by 49 acres during this same period. Portuguese broom (*Cystus striatus*), French broom, and several other weeds also likely were established and/or expanded their distribution at the site. It was estimated that the mission blue butterfly and the callippe silverspot butterfly could have been extirpated from San Bruno Mountain within 5-20 years due to the projected loss of grassland habitat (Thomas Reid Associates 1982).

Management efforts conducted since 1982 under the San Bruno Habitat Conservation Plan has reduced gorse by approximately 290 acres and blue gum eucalyptus by approximately 45 acres. Invasive plant management also has been conducted on French broom, Portuguese broom, and Monterey pine. Thomas Reid Associates (2004) reported controlling 49 species of invasive plants on San Bruno Mountain as of 2003. Although this is an increase in the number of plants being managed since the section 10(a)(1)(B) permit was issued in 1983, the nature of the threat, the displacement of larval food plants by invasive plant species, remains the same as it was when the San Bruno Mountain Habitat Conservation Plan was prepared in 1982. Invasive plant control has been and continues to be the focal point of habitat management on San Bruno Mountain.

The San Bruno Mountain Habitat Conservation Plan has not focused on controlling the spread of coastal scrub into grassland for several reasons (County of San Mateo 2007): 1) lack of available funding and/or in-kind services; 2) air quality regulations have restricted opportunities for controlled burns; 3) lack of maintained fire breaks and decreased fire break management; 4)

lack of grazing infrastructure that would allow testing and reintroduction of grazing to maintain fore breaks and/or reduce brush and invasive species; and 4) concern by the Plan Operator that incidental take of the endangered callippe silverspot butterfly during management activities without authorization from the Service could result in violations of the Act.

Effects of the Proposed Action

The Amendment will contribute to the survival and recovery of the callippe silverspot butterfly, San Bruno elfin butterfly, mission blue butterfly, Bay checkerspot butterfly, San Francisco garter snake, and San Francisco lessignia. However, the proposed action will result in development-related adverse effects to the callippe silverspot butterfly and mission blue butterfly on 4.85 acres; the development of 25.21 acres of habitat for these two listed animals is authorized under the San Bruno Mountain Habitat Conservation Plan. The revised operating plan for the Northeast Ridge will result in Conserved Habitat that is larger in size and higher in biological value than the habitat that will be lost as a result of the Amendment. The revised operating plan has a reduced development plan that avoids impacts to a hilltop area important to the callippe silverspot butterfly's' mating success, reduces impacts to the larvae food plants of the mission blue butterfly and callippe silverspot butterfly, reduces impacts to habitat by approximately 50%, including both temporary and permanently disturbed areas, compared to the development plan currently approved under the Section 10(a)(1)(B) permit, and reduces habitat fragmentation by removing a cluster of development on the hilltop area. There will be some incidental take of the callippe silverspot butterfly, mission blue butterfly, and possibly the San Bruno elfin butterfly and the San Francisco garter snake, and adverse effects to the San Francisco lessignia, as a result of the proposed management and monitoring activities. The funding element of the Amendment will provide significant amounts of money for the management of San Bruno Mountain, without which the habitats utilized by the callippe silverspot butterfly and mission blue butterfly will decline to such a point that these two endangered species are highly likely to become extirpated from this site in the foreseeable future. Failure to implement additional management likely will result in a loss of habitat which the Bay checkerspot butterfly can naturally recolonise or be successfully introduced.

Both the revised Northeast Ridge development plan and habitat management and monitoring were analyzed in the Service's biological opinion (1-1-06-F-0937), which concluded these and other activities will not jeopardize the callippe silverspot butterfly and the other listed species on San Bruno Mountain or result in adverse modification of designated critical habitat.

I. Reconfiguration of Conserved Habitat, Proposed Development, and Related Development Activities within the Northeast Ridge

The change in configuration of the Conserved Habitat contained in the Amendment will reduce potential impacts to the callippe silverspot butterfly and the mission blue butterfly because it will have a smaller development footprint through the elimination of Hillcrest Neighborhood I than the current section 10(a)(1)(B) permit that includes the Northeast Ridge. This portion of the Amendment is not likely to result in take of the San Bruno elfin butterfly, Bay checkerspot butterfly, San Francisco garter snake, or adverse effects to the San Francisco lessignia. The Amendment's conserved hilltop habitat that would have been

impacted under the approved section 10(a)(1)(B) permit.

Historically, the southern portion of San Bruno Mountain has had higher numbers of the mission blue butterfly and the callippe silverspot butterfly than the Northeast Ridge. During the 2007 monitoring on San Bruno Mountain, the majority of mission blue butterflies were observed on the Southeast Ridge and South Slope, fewer numbers were seen on the Northeast Ridge (Thomas Reid Associates 2008). In 2008, the majority of callippe silverspot butterflies, 269 animals, were observed on the southern portion of San Bruno Mountain east of the Radio Ridge parking lot; 89 individuals were observed on the Northeast Ridge (Thomas Reid Associates 2009).

The callippe silverspot butterfly and the mission blue butterfly could be harassed, injured, or killed as a result of construction activities, young and eggs could be injured or killed as a result of being crushed or buried by earth moving activities, including temporary disturbances and permanent loss of habitat. Increased levels of dust caused by construction or other earth moving activities could clog the spiracles and asphyxiate the early stages of the two species, and thus cause their death by asphyxiation. Ehrlich (1984) reported the common alpine butterfly (*Erebia epipsodea*) was abundant between 1960 and 1970 in the upper East River drainage of Gunnison County, Colorado, and it became scarce in the early 1980s; he speculated that this could possibly be the result of the most obvious major change in its habitat which was the increase in dust caused by increased vehicle traffic. However, the inclusion of dust control measures during construction activities should minimize any potential effects to these butterflies.

The 2007 Vesting Tentative Map results in less fragmentation than the 1989 Vesting Tentative Map due to clustering of the development in Landmark Neighborhood II. The deletion of Hillcrest Neighborhood I will result in a larger, contiguous grassland habitat block that includes the two primary hilltop areas on the Northeast Ridge: Callippe Hill and an unnamed hill to the east. While Callippe Hill has been conserved as habitat through the San Bruno Mountain Habitat Conservation Plan, the 1989 Vesting Tentative Map would have severely impacted the unnamed hill to the east. The 2007 Vesting Tentative Map increases the amount of development near Guadalupe Canyon Parkway, but it is not expected that this will present a significant barrier to the callippe silverspot butterfly. Habitat would be protected on all four sides of the Carter Street/Guadalupe Canyon Parkway intersection, including a narrow hilltop that will be partially temporarily disturbed. At the current time, movement of this endangered species in this area is partially restricted by a 9.09 -acre eucalyptus grove that would be removed under the 2007 Vesting Tentative Map. An emergency vehicle access that is part of the 2007 Vesting Tentative Map will connect the development to Guadalupe Canyon Parkway. The emergency vehicle access will have a smaller footprint and will be less trafficked than the public roadway planned in the 1989 Vesting Tentative Map.

Direct impacts to callippe silverspot butterfly and mission blue butterfly would result from the loss of host and nectar plant habitat. In summary, the development of the 2007 Vesting Tentative Map would require grading of 19.64 acres of undisturbed habitat, including 2.97 acres that will be restored pursuant to the restoration guidelines in the Habitat Management

Plan. An additional 1.07 acres of previously undisturbed habitat have been impacted by the 2007 Infrastructure Grading. The 16.67 acres that would be permanently disturbed, and the 1.07 acres disturbed by the 2007 Infrastructure Grading include approximately 12.01 acres of grassland habitat.

The 2007 Vesting Tentative Map will avoid the high value hilltop and larvae foodplants in Hillcrest Neighborhood I approved under the 1989 Vesting Tentative Map, it will result in impacts to downslope habitat containing Johnny jump up and lupines along the northerly boundary of Landmark Neighborhood II. The proposed temporary disturbance associated with the development would impact an area that is approximately 880 feet long and 100 to 200 feet wide, located on the south side of a ridgeline. This area is located approximately 100 feet south of Guadalupe Canyon Parkway. This ridgeline has consistently been utilized by the callippe silverspot butterfly (Thomas Reid Associates 2003-2005), as do hilltops and ridgeline areas to the north and east. The impact from grading on the south side of the ridgeline is anticipated to have a temporary impact because the topographic high point of the ridgeline will remain and continue to provide hilltopping habitat for the callippe silverspot butterfly. After grading, the area will be restored to grassland habitat.

The major effects of the changes to the Northeast Ridge are:

1. *The 2007 Vesting Tentative Map will change the boundary of the Conserved Habitat within the Northeast Ridge.* The Amendment will designate new Conserved Habitat within Landmark Neighborhood II of the Northeast Ridge that is larger in size and higher in biological value than the habitat that will be lost by eliminating the permanent and temporary disturbances within an approximately 21 acre hilltop area associated with development. Approximately 0.84 acre of existing Conserved Habitat will be lost through development under the Amendment; this area consists primarily of a eucalyptus grove, which does not provide habitat for the callippe silverspot butterfly and the mission blue butterfly. The net increase in Conserved Habitat will be 8.93 acres. To put the loss of grassland habitat in perspective, approximately 122 acres of grasslands on San Bruno Mountain have converted to coastal scrub between 1982 and 2004 (County of San Mateo 2007). The reconfiguration of the Conserved Habitat boundary reduces impacts to the larvae foodplants of the callippe silverspot butterfly and the mission blue butterfly by reducing permanent and temporary disturbances and reduces habitat fragmentation by clustering development.

2. *Reduced impacts to hilltops utilized by the callippe silverspot butterfly and conservation of grassland utilized by both listed butterflies.* Hilltop habitat is important for the callippe silverspot butterfly because the adult males patrol for females on summits and ridgetops, while females fly uphill to mate and downhill to oviposit within areas containing Johnny jump-up. The grassland also supports lupines and nectar plants utilized by the mission blue butterfly. The 2007 Vesting Tentative Map significantly reduces impacts to hilltop and downslope ovipositing habitat for both of these endangered species by eliminating the development of Hillcrest Neighborhood I. The site of Neighborhood I was described as "...prime habitat for both butterfly species, particularly the [callippe]" (Murphy 1989). Murphy (1989) stated that the proposed Neighorhood I

"...has greater negative impacts that development in other Northeast Ridge areas."

3. *Potential Movement Barriers.* Barriers to movement of the callippe silverspot butterfly and mission blue butterfly were investigated during the 1980-1981 biological studies (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982). Although, urbanization of the Crocker Industrial Park in Visitacion Valley, which is 600 feet wide at its narrowest point, was assumed to be a total barrier, callippe silverspot butterflies were found to fly between the Southeast Ridge and the Northeast Ridge. Individuals made this journey, by moving through the Industrial Park, or through Conserved Habitat around the western perimeter of the Valley. Dense clusters of tall trees, paved roads, and residential lots were identified as "partial barriers," scattered trees and dense brush as "minimal barriers," and cyclone fences, dirt roads and scattered brush as "no barrier" (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982).

   The development of the 2007 Vesting Tentative Map would be located in an area that is dominated by grassland and blue gum trees (*Eucalyptus globolus*). Current and historical data document callippe silverspot butterflies and mission blue butterflies using the grassland habitat on the slope below the blue gum trees. The blue gum eucalyptus grove is approximately 25 to 350 feet wide and it extends north to south through Unit II of the Northeast Ridge. Callippe silverspot butterflies have been observed moving through the grove in the narrow areas; however, in the widest areas, the trees and understory are a potential partial barrier to their movement. The 6.82 acres of gum trees will be cut and thinned in the 7.85 acre eucalyptus grove in Unit II; 1.02 acres would remain and there will be a minimum of 45 feet between the trees. The barrier to movement by the callippe silverspot butterfly and mission blue butterfly will be significantly reduced by the cutting and thinning.

   The proposed development under the 2007 Vesting Tentative Map includes the construction of 71 homes within 16.67 acres. These homes will be two stories high, and the permanent footprint of the development ranges from approximately 50 to 1300 feet across. Temporary disturbance will add an additional 100 to 200 feet to the width of the project footprint, although these areas will not contain structures that could serve as a barrier to butterfly movement and will be restored. The residential development likely will not be a barrier to the callippe silverspot butterfly and the mission blue butterfly because of their ability to fly through the cut and thinned eucalyptus grove, open areas, spaces between the homes, and around the north side of the development.

   The existing four-lane Guadalupe Canyon Parkway located directly to the north of the Northeast Ridge is not a permanent barrier to the mission blue butterfly and the callippe silverspot butterfly, however, the number of animals that are able to move across this road is dependent on various factors, including the amount of traffic and the speeds of the vehicles. Several studies have found that roads do not appear to substantially restrict the movement of butterflies (Mungira and Thomas 1992; Ries and Debinski 2001; Ries *et al.* 2001; Saarinen *et al.* 2005; Valtonen and Saarienen 2005). However, in these studies, butterflies with different dispersal tendencies also differed in their behavioral repose to road edges. The more vagile, strong flying species were less sensitive to road barriers

(Mungira and Thomas 1992; Ries and Debinski 2001) than species that were either habitat specialist (Ries and Debinski 2001) or those that were not efficient dispersers (Mungira and Thomas 1992; Valtonen and Saarinen 2005). The callippe silverspot butterfly is a strong, fast, direct flier (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982).

Although roadways many not be a significant barrier to butterflies, the vehicles that travel on them result in significant levels of mortality to them (Mungira and Thomas 1992; McKenna *et al.* 2001; Ries *et al.* 2001). When it has been measured, usually <10 percent of butterflies from study populations experience direct vehicle mortality (Mungira and Thomas 1992; Ries *et al.* 2001; Valtonen and Saarinen 2005), although McKenna *et al.* (2001) suggested a higher proportion of mortality of possible. McKenna *et al.* (2001) found that at the number of butterflies killed by vehicles on a roadway in Champaign, Illinois, with comparable traffic levels to Guadalupe Canyon Parkway, ranged from 1.30 butterflies to 49.30 butterflies per 300 feet of roadway. The average number of cars on the roadway in a 24 hour period was 13,500 vehicles in Illinois and 11,600 vehicles on Guadalupe Canyon Parkway (California Public Utilities Commission 2003). However, the majority of butterflies found dead in Illinois were sulphur butterflies (*Colias eurytheme/Colias philodice* complex), a species whose flight behavior is different than the mission blue butterfly and the callippe silverspot butterfly. In addition, the majority of traffic on Guadalupe Canyon Parkway is during the "rush hour" in the early morning and early evening hours, periods when the two listed butterflies have not yet begun flying, or are less likely to be active. Surprisingly, McKenna *et al* (2001) found that butterfly mortality declined at the highest traffic levels (19,700 vehicles and 26,000 vehicles per 24 hours). Among other reasons, they speculated that at speeds of 55 miles per hour and greater, butterflies were caught in a "wind current" going over the roof of the car, with the result that the animals were "catapulted" over the vehicle instead of colliding with it.

Severns (2008) reported on three different observations of interactions between the endangered Fender's blue butterfly, a subspecies that is closely related and similar in behavior to the mission blue butterfly. Most individuals of Fender's blue butterfly flew within 1.5 feet of the ground while crossing the road. The animals also made many small turns, appearing to zigzag and retrace areas of the road previously covered. This type of flight is characteristic for Fender's blue butterfly (Schultz 1998; Schultz and Crone 2001) and the mission blue butterfly (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982; C.D. Nagano, pers. obs), while they are searching for resources, especially when compared to the relative straight, higher elevation flight when they encounter unsuitable habitat. Severns (2008) found that the cars were traveling around 25 miles an hour and when the Fender's blue butterflies detected the vehicles, they flew to either side of the road about 30 feet before the cars reached their vicinity; he did not find any dead individuals by the side of the road. However, Severns (2008) noted that the road did not have frequent vehicle traffic, about 30-60 cars/day, and it is relatively narrow, compared with other roads; he also suggested that because of its behavior, Fender's blue butterfly has a greater potential for mortality on wider roads with heavier amounts of vehicle traffic.

Callippe silverspot butterflies are strong fliers, as are members of the genus *Speyeria* as a whole (Howe 1975). At San Bruno Mountain, mark-release-recapture data revealed that numerous callippe silverspot butterflies flew 0.8 mile from one breeding colony to the other, and 5 to 6 percent of individuals traveled even farther (Thomas Reid Associates 1982). These data seem consistent with data for the regal fritillary butterfly, a member of the same genus as the callippe silverspot butterfly. Regal fritillary adults move an average of 220 feet per day, but some individuals moved up to 1.1 miles (Nagal *et al.* 1991).

The callippe silverspot butterfly has been observed flying across Guadalupe Canyon Parkway during annual monitoring over the past 25 years. The mission blue butterfly was observed on two occasions crossing Guadalupe Canyon Parkway, and once crossing a 40-foot wide road at Twin Peaks (San Bruno Mountain Habitat Conservation Plan Steering Committee 1982). There is Conserved Habitat on both sides of Guadalupe Canyon Parkway - the Saddle and Rio Verde parcels on the north, and the Northeast Ridge Water Tank Parcel and the Northeast Ridge on the south. After development of the 2007 Vesting Tentative Map, the Conserved Habitat along the south side of Guadalupe Canyon Parkway will vary in width from approximately 87 feet to 250 feet. Habitat on the north side of Guadalupe Canyon Parkway will not be affected by the construction of Unit II.

The proposed development of Landmark Neighborhood II is located within an area of high usage by the callippe silverspot butterfly and mission blue butterfly. The implementation of the 2007 Vesting Tentative Map will not result in a complete barrier to east-west movement of the two listed animals along the north side of proposed residential units 39-50, which are directly south of Guadalupe Canyon Parkway, or prevent movement back and forth over Guadalupe Canyon Parkway.

II. Funding Elements as Described in the Amendment

The Amendment will significantly increase the funds available for habitat management and monitoring on San Bruno Mountain, which otherwise could not be implemented by the Plan Operator. These activities will play a key role in ensuring the survival and recovery of the callippe silverspot butterfly, mission blue butterfly, San Bruno elfin butterfly, and San Francisco garter snake. The enhancement and maintenance of grassland for the larvae foodplants and adult nectar sources is critical for the mission blue butterfly and callippe silverspot butterfly. The management of dwarf plantain, secondary foodplants, and nectar plants for the Bay checkerspot butterfly will ensure suitable habitat is available should this animal be reintroduced or naturally recolonise San Bruno Mountain.

The Amendment will provide funding to protect and restore grassland butterfly habitat on a much more thorough scale than is possible under the current management budget, and support ongoing grazing and brush removal experiments and invasive species control. The additional funding will be used to control and manage coastal scrub succession which has caused the loss of approximately 122 acres of grasslands within Conserved Habitat between 1982 to 2004 on San Bruno Mountain (County of San Mateo 2007). Clearing coastal scrub from former grassland areas and controlling invasive weeds will allow for natural recruitment of Johnny jump up and

lupines into reclaimed grassland areas. In the vicinity of the Northeast Ridge, the additional funds will be used to manage Conserved Habitat on both sides of Guadalupe Canyon Parkway and the area around the water tank, including the removal of coastal scrub and invasive exotic and native species that are currently encroaching on grassland. Specific parcels that would directly benefit include those that have had a significant decline in occupancy by the callippe silverspot butterfly, mission blue butterfly, and their larvae foodplants and nectar sources over the span of the San Bruno Mountain Habitat Conservation Plan, include the Rio Verde parcels, Northeast Ridge Water Tank Parcel, and the McKesson parcel. Coastal scrub succession and to a lesser extent, invasive weed infestation, has replaced the grassland habitat for these two endangered species in these areas. The revised operating plan for the Northeast Ridge also requires the developer, Brookfield Northeast Ridge II, to fund the management of the 78.27 acres of proposed Conserved Habitat within the Northeast Ridge prior to dedication of this parcel to the State and County Park. The Trustees for the San Bruno Mountain Habitat Conservation Plan will be able to collect the annual habitat conservation plan fees and build up the endowment prior to taking over management responsibilities.

III. Management and Monitoring of Conserved Habitat

A significant amount of San Bruno Mountain has been protected as open space, however, the species diversity and vegetative cover of invasive, exotic plants and an increase in the amount of coastal scrub habitat have increased significantly since the issuance of the section 10(a)(1)(B) permit (County of San Mateo 2007). Weed control activities have focused on larger plants, such as gorse, fennel, and eucalyptus, but more attention is required to control and manage weedy grasses, such as quaking grass (*Briza maxima*), wild oats, ripgut, and small forbs, including yellow oxalis, sheep sorrel, and English plantain.

The activities described in the Amendment and the Habitat Management Plan will result in some adverse effects to the listed butterflies, and San Francisco garter snake, but the overall long term effects will be beneficial. Without implementation of the management activities, the San Bruno elfin butterfly likely will decline in status, and the callippe silverspot butterfly and the mission blue butterfly are highly likely to be extirpated in the forseeable future from San Bruno Mountain. The Amendment includes implementing several actions described in the recovery plan for the San Bruno elfin butterfly and mission blue butterfly (Service 1984).

Implementation of the management actions may result in the death, injury, harassment, or harm of the mission blue butterfly, San Bruno elfin butterfly, callippe silverspot butterfly, Bay checkerspot butterfly, and the San Francisco garter snake, and adverse effects to the San Francisco lessingia due to clearing of vegetation and other activities associated with hand clearing, flaming, herbicides, livestock grazing, prescribed burning, pile burning, mowing, mechanical clearing, replanting/restoration, suppression, and mechanical treatment. However, these activities are necessary to eliminate or control invasive exotic and native plants that compete with the plants utilized by the listed butterflies, degrade or eliminate habitat for the San Francisco garter snake, or degrade the habitat or outcompete the San Francisco lessingia, and thus result in significant long-term benefits to the survival and recovery of them in the wild.

The elimination of exotic invasive plants and coastal scrub habitat will result in areas on San Bruno Mountain becoming temporarily unvegetated, but the Habitat Manager will restore them with appropriate native plant species. Although some patches of habitat occupied by the listed species may become temporally isolated, these open areas are unlikely to prevent the dispersal and gene flow of the listed butterflies and the San Francisco garter snake. Movements and dispersal corridors between habitat patches is critical to their population dynamics. Movement between population centers maintains gene flow and reduces genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects.

San Francisco Lessingia

The potential effects of the proposed management and monitoring of Conserved Habitat on the San Francisco lessingia include direct mortality from burning, mowing, and clearing, or being crushed by vehicles, project-related personnel, or associated equipment. Potential harmful or injurious effects include impairment of respiratory and photosynthesis processes due to smoke resulting from project activities. Alteration of microhabitats may include the destruction of cryptogamic crusts that help to exclude invasive non-native plants and improve water infiltration. Below ground effects include loss or degradation of soil structure, fertility, porosity, and water holding capacity. Below ground effects also include potential loss of seed banks which are vital to re-establishing broadly distributed populations.

The management activities and their potential effect on the listed species are:

1. *Hand Work. Mowing, and Mechanical Clearing:* Harm, harassment, injury, or mortality of the four listed butterfly species, San Francisco garter snake, and the San Francisco lessingia may result from crushing, capturing, poisoning, or otherwise damaging individuals that may be located within restoration and enhancement areas due to vegetation removal, use of Roundup and other herbicides, use of vehicles or motorized equipment that could crush individuals, crew movement, debris removal, and maintenance activities that may include vehicles, motorized equipment, and vegetation removal. Work activities may harass adult butterflies causing them to flee the area; this disturbance may increase the potential for predation or their escaping to unsuitable habitat. Behavioral disturbance to the listed animals may result in an energetic expense that could reduce individual fitness.

   The San Francisco garter snake could be crushed, entombed in its burrows, hit and injured or killed by vehicle strikes, harassed by noise and vibration, poisoned, burned, and a reduction in natural food sources as a result of the management activities. This endangered reptile may become trapped if plastic mono-filament netting is used for erosion control or other purposes where they would be subject to death by predation, starvation, or desiccation (Barton and Kinkead 2005; Stuart *et al.* 2001). In November 1993, unauthorized grading of a dirt road by a public utility near Buckeye Canyon resulted in significant erosion problems (C.D. Nagano, pers. obs.). The unapproved remediation measures included hay bales secured with plastic monofilament netting that trapped large numbers of western yellow bellied racers (*Coluber constrictor*), kingsnakes

(*Lampropeltis getula*), and western gopher snakes (*Pituophis melanoleucus*) over the timespan of a few days. All of the snakes either died because the plastic netting cut into their bodies during their struggles to escape and they bled to death or died of exposure, or raccoons and other predators ate them.

2. *Herbicide Use:* The use of pesticides and herbicides could result in adverse effects to the listed butterflies if their use occurs within or in close proximity to occupied habitat. Herbicides pose a threat to these animals if they kill the larvae foodplants or the nectar sources, or if the surfactant used in the herbicide has insecticidal effects. Larvae of species in the genus *Speyeria* are extremely sensitive to pesticides, and even the accumulation of runoff in the soil after spraying has proven lethal to these larvae (Mattoon *et al.* 1971; Mattoon *et al.* undated).

3. *Livestock Grazing:* In moderation or at low levels, grazing will maintain habitat (e.g., Weiss 1999) for the four listed butterflies. Appropriately timed, low-intensity grazing will reduce the invasion of invasive exotic and native plants. Such benefits must be weighed against the possible trampling of the early stages of the butterflies and their host and nectar plants. Grazing by Pleistocene herbivorous mammals and then domestic livestock occurred in areas inhabited by all four of these insects. Livestock grazing once occurred in some of the areas on San Bruno Mountain currently inhabited by the mission blue butterfly and callippe silverspot butterflies.

4. *Flaming, Prescribed Burning, and Pile Burning:* Historically, fire played a major role in maintaining California grasslands occupied by the callippe silverspot butterfly (Heady 1988) and mission blue butterfly. These two species have behavioral and biological adaptations to cope with fire, and their populations can be maintained in a landscape with cool burning fast moving grassland fires. However, if hot burning slow fire moves through a grassland when eggs, larvae, or pupae are present, it likely kills them. If fire occurs during the summer flight period of the callippe silverspot butterfly or the spring flight period of the mission blue butterfly, we expect that most, if not all, adults present will avoid death by flying away from the fire. After the fire is out, adults return to the burned areas in search of host plants and nectar plants. This behavior was observed in the regal fritillary butterfly (Huebschman and Bragg 2000). However, at one site in the midwestern United States, the abundance of this species was reduced for a period of 3 to 5 years following the application of fire due to the impacts on larvae food plants and adult nectar sources (Swengel 1996). Grassland fires in the San Francisco Bay area often leave patches of unburned habitat. The callippe silverspot butterfly and mission blue butterfly likely will use host plants and nectar plants in these unburned areas. On a longer time scale, a mosaic of fire in a large habitat area could be beneficial if it retards coastal scrub invasion or otherwise promotes growth of the host plant and nectar plants.

   The foodplants of the larvae and/or adult nectar plants could be eliminated by burning. Insects breathe via spiracles and inhalation of smoke particles could prevent their respiration and result in their asphyxiation. Deposits of high amounts of smoke particles on the larvae food plants can abrade leaves, and adversely affect photosynthesis (Thompson *et al.* 1984). Particle cover on leaves can also induce an increase in leaf

temperature from greater absorption of incident radiation resulting in reduced net photosynthesis and productivity (Eller 1977; Hirano *et al.* 1995). Dust abatement measures that include the wetting or dampening of exposed ground surfaces may result in adverse effects. Unseasonal moisture may trigger untimely germination of seeds when growing conditions are unfavorable. Seeds may potentially germinate followed by dessication and the eventual death of seedlings, a process that has been used as an eradication method for the invasive yellow star thistle (DeTimoso, Univ. of California at Davis, pers. comm., 2000). Alteration of microhabitats may include the destruction of cryptogamic crusts that help to exclude invasive non-native plants and improve water infiltration. Below ground effects include loss or degradation of soil structure, fertility, porosity, and water holding capacity. These effects typically result from the soil compaction associated with the activities included as part of the Habitat Management Plan. Below ground effects also include potential loss of seed banks which are vital to re-establishing broadly distributed populations.

Since fire is an important component of natural ecosystems in California, the mechanical treatment and prescribed fire portions of the Habitat Management Plan likely will result in long-term beneficial effects to the San Francisco garter snake through the maintenance of habitat for this endangered species. However, in the short term, heat and smoke from the fires may kill or injure individuals. Individuals of the San Francisco garter snake may be adversely affected by increased levels of sedimentation into aquatic habitats caused by runoff from burned areas. If heavy sedimentation occurs in ponds or other water bodies where the Pacific treefrog prey of the San Francisco garter snake breeds, it is possible that eggs and tadpoles will suffocate because of the silt, and reduce or eliminate the listed reptile at the site. Without adequate measures, heavy loss of sediments from the streambed may result in down-cutting of channels which could further degrade the stability of banks, and functions of the riparian ecosystem. Excess sedimentation or excess numbers of fire-associated personnel and their vehicles and equipment could damage or destroy the mammal burrows used by the aestivating or hibernating snakes. There is no scientific information on members of the genus *Thamnophis* response to smoke exposure; however, gophers and California voles have higher metabolisms than snakes and easily persist through light fires in grasslands and removal of shrub canopy.

Voles and gopher burrow densities may increase significantly as a result of the mechanical treatment and prescribed fire portions of the proposed project. Gopher burrows vacated as a result of predation by raptors are typically occupied by voles. Voles and gopher burrows will create the sub-surface structure sufficient for San Francisco garter snake retreat and hibernation sites. Gopher burrows are a known escape refugia for San Francisco garter snakes and are often used as hibernacula. San Francisco garter snake populations are dependent on sufficient hibernacula, situated adjacent to foraging habitat.

5. *Replanting/Restoration:* An effect of the proposed project on the listed butterflies is the elimination of their habitat due to invasive exotic and native vegetation invading areas where restoration has not been implemented or is inadequate. Soil disturbance, as associated with project associated activities, facilitates the invasion of areas by non-

native species. Increased human activity can introduce new species to an area. Although many of these plants do not survive or thrive in the areas to which they are introduced, some do. These plants could eventually displace or otherwise out-compete the plants which are depended upon by the callippe silverspot butterfly and the mission blue butterfly.

Habitat management activities that do not use locally collected native plant species could result in adverse effects to the four listed butterflies on San Bruno Mountain. Adult female butterflies who have been reared on different plant species may "imprint" on their chemical signature and not recognized other foodplants (Tom Emmel, McGuire Butterfly Center, pers. comm. to David Kelly and Chris Nagano), and native, but non-local, foodplants may contain biochemical components that are poisonous to herbivorous insects (Longcore *et al.* 1999).

While restoration biologists have had great success with increasing the abundance of host plants for the mission blue butterfly at San Bruno Mountain, no attempts were made to enhance populations of Johnny jump-up until 2001. This plant requires deep soils with established grass cover, making it more difficult to establish than the shallow soil-tolerant lupine species used by the mission blue butterfly (Thomas Reid Associates 2002). After years of weed control, hydroseeding, and erosion control, some areas at the Northeast Ridge and Terrabay of San Bruno Mountain now support new populations of Johnny jump up (Thomas Reid Associates 2002). Seedlings were started for planting in 2001, but did not survive transplanting. The first plantings were then scheduled for 2002, however, survival rates were also low. PG&E has also had promising but limited success with their propagation. Most recently, Thomas Reid Associates reported two successes in propagating Johnny jump up. In the first success, plants that had been produced in a nursery survived outplanting with only a one-year turnaround, which bodes well for growing plants to be used in restoration activities in a nursery. In the second success, a direct seeding trial on the Northeast Ridge suggests that seeds can germinate successfully in the field (Patrick Kobernus pers. comm).

IV. Bay checkerspot Butterfly Critical Habitat

The proposed action is not expected to appreciably diminish the value of the critical habitat for the Bay checkerspot butterfly, or prevent the critical habitat from sustaining its role in the conservation and recovery of the species. Management activities that would result in temporary impacts within critical habitat will remove or control exotic plant species and likely will enhance the primary constituent elements, or will be of a relative small size and will be of an insignificant or discountable nature. Amending the San Bruno Mountain Habitat Conservation Plan will allow for development in the Northeast Ridge, which is not located within critical habitat; the additional funding included in the Amendment will be provided for invasive plant species control and management that likely will enhance the primary constituent elements not only within the critical habitat unit, but throughout San Bruno Mountain.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

From 1995 to 2020, the human population is projected to increase by 18 percent for the San Francisco Bay hydrologic region (California Department of Water Resources 1998). According to the California Department of Forestry, from 2000 to 2020, the human population in the Bay Area region is expected to grow by 29 percent (5.3 million people to 6.8 million people), and by 60 percent from 2000 to 2040 (5.3 million people to 8.4 million people) (California Department of Finance 1998). San Bruno Mountain is a population site for hiking, picnicking, and other passive forms of recreation. Therefore, the number of human visitors will increase with concomitant adverse effects on the San Francisco garter snake and the four listed butterflies, including air pollution, trampling, release of exotic species, and poaching.

The continued spread and increasing density of exotic plant species and coastal scrub habitat will continue to degrade and eliminate habitat for the San Francisco garter snake, mission blue butterfly, San Bruno elfin butterfly, Bay checkerspot butterfly, and the callippe silverspot butterfly. The cumulative effects of these threats pose a significant impediment to the survival and recovery of these species unless the restoration, enhancement, and management of the Conserved Habitat on San Bruno Mountain is successful.

Drift from insecticide spraying for pest insects, such as exotic fruit flies from areas surrounding San Bruno Mountain could adversely impact the four listed butterflies on San Bruno Mountain. Control measures for the exotic light brown apple moth (*Epiphyas postvittana*) likely will include a multiphase approach using insecticides, insect growth regulators, spinosyns, and *Bacillus thuringlensis* var. *kurstaki*), a disease-causing bacterial strain specific to butterflies and moths (Lepidoptera)(Varela *et al.* 2008); the use of any of these agents in the vicinity of San Bruno Mountain could adversely affect the four listed butterflies.

Urban development results in increased numbers of pets. Both feral and domestic cats (*Felis catus*) and dogs (*Canis lupus familiaris*) prey on aquatic and riparian species including the San Francisco garter snake. People exploring creeks and wetlands on San Bruno Mountain may harass, collect, and kill this listed species.

Non-native species that prey upon, or compete with, listed species continue to be released in the San Francisco Bay Area, including San Bruno Mountain. Bullfrogs likely will be released in the future, and they likely will eat the San Francisco garter snake. Sowbugs and earwigs are predators on eggs, larvae, and pupae of butterflies (Edney *et al.* 1974; Langston and Powell 1975; Mattoni *et al.* 2003), likely including the four listed species on San Bruno Mountain.

The endangered San Francisco garter snake is a species that is highly valued in the international reptile trade (retired Special Agent K. McCloud pers. comm. to C.D. Nagano). For example, the marsh near the San Francisco International Airport is a well-known collecting site for this

imperiled animal. Low numbers, and scrutiny by residents, make poaching less lucrative at the Mori Point area at Pacifica than it has been in the past. Poaching from small or isolated populations of this listed species may result in their extirpation. The internet has become a popular venue for the international commercial trade in reptiles and amphibians. Poachers collecting non-listed reptiles, such as the western yellow bellied racers and western gopher snake, on San Bruno Mountain likely would collect any San Francisco garter snakes they encounter.

A threat to the mission blue butterfly, San Bruno elfin butterfly, Bay checkerspot butterfly, and the callippe silverspot butterfly is the illegal collection for commercial and personal purposes. Adult specimens of these species are highly valued by private collectors, and an international market exists for illegally collected specimens of them, as well as other listed and rare butterflies (Ehrlich 1984; Collins and Morris 1985; U.S. Attorney's Office 1994; Williams 1996). Butterflies in small populations are vulnerable to harm from collection of adult butterflies (Gall 1984a, 1984b). A population may be reduced to below sustainable numbers (Allee effect) by removal of females, reducing the probability that new colonies will be founded. Collectors pose a threat because they may be unable to recognize when they are depleting butterfly colonies below the thresholds of survival or recovery (Collins and Morris 1985; Hayes 1981). In the late 1980s, colonies of the endangered Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*) in small wetlands in western New Jersey were visited on an almost daily basis by collectors who captured every specimen they could find. After a few seasons these colonies vanished (Gochfield and Burger 1997). Colonies of some species of giant skippers in the Megathymidae reportedly have been lost after collectors due up the yucca foodplants so they could rear the larvae in order to obtain perfect specimens of these extremely difficult to collect animals (Cech and Tudor 2005). The extirpation of the large copper butterfly (*Lycaena dispar*) in Great Britain was preceded by heavy bouts of collecting (Duffey 1968, 1977). A convicted collector had large numbers of callippe silverspot butterflies and mission blue butterflies in his collection (C.D. Nagano, pers. obs.; U.S. Attorney's Office 1994). This same poacher stated that collecting San Bruno elfin butterfly was easily accomplished on Radio Ridge on San Bruno Mountain because few people were in the area during the week, and individual adults can easily be collected when they are perching on the Pacific stonecrop that grow along the roadside cliff faces (C.D. Nagano, pers. obs). A poacher was observed collecting butterflies on San Bruno Mountain in 1994 (Service 1997).

Mountain bikes using trails on San Bruno Mountain could run over and kill San Francisco garter snakes, and other reptiles and amphibians. Death of listed reptiles caused by mountain bikes, including the threatened Alameda whipsnake (*Masticophis lateralis euryxanthus*) in East Bay Regional Parks in Alameda County, has been documented by Vandeman (2008). In addition, these vehicles increase rates of erosion on trails which degrades the habitat of listed species and wildlife (Chiu and Kriwoken 2003). Mountain bike riders are higher off the ground and travel much faster than hikers, and if they do not keep most of their attention on negotiating the trail, they crash; thus, it extremely difficult for them to ride their bikes and look out for small animals, such the San Francisco garter snake, on the trail. The listed reptiles and other animals may not have a chance to move out of danger because the mountain bikes move too quickly for them to escape.

Hardy (1957) speculated that in British Columbia, Pacific stonecrop, the larvae foodplant of the nominate Moss's elfin butterfly (*Incisalia mossii mossi*), could be seriously damaged by rock climbers and hikers. Hikers on San Bruno Mountain could damage this plant and associated San Bruno elfin butterflies in the same manner.
Air pollution destroys volatile hydrocarbons reduced from flowers that serve as signals to potential pollinators (McFrederick *et al.* 2008). Increases in air pollutants, such as ozone, may interfere with the foraging efficiency of the four listed butterflies on San Bruno Mountain.

An increase in atmospheric CO^2 from Global Climate Change may alter nectar production in some plant species, which could negatively affect the four listed butterflies on San Bruno Mountain (reviewed by Davis 2003). An additional impact of Global Climate Change is increased amounts of UV-B radiation from a reduction in ozone, which could delay flowering in some plants and reduce the amount of flowers they produce (National Research Council 2007).

The global average temperature has risen by approximately 0.6 degrees centigrade during the 20th Century (International Panel on Climate Change 2001, 2007; Adger *et al* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (International Panel on Climate Change 2001, 2007; Adger *et al.* 2007), and that it is "very likely" that it is largely due to increasing concentrations of greenhouse gases (carbon dioxide, methane, nitrous oxide, and others) in the global atmosphere from burning fossil fuels and other human activities (Cayan *et al.* 2005, EPA Global Warming webpage http://yosemite. epa.gov; Adger *et al.* 2007). Eleven of the twelve years between 1995 and 2006 rank among the twelve warmest years since global temperatures began in 1850 (Adger *et al.* 2007). The warming trend over the last fifty years is nearly twice that for the last 100 years (Adger *et al.* 2007). Looking forward, under a high emissions scenario, the International Panel on Climate Change estimates that global temperatures will rise another four degrees centigrade by the end of this Century; even under a low emissions growth scenario, the International Panel on Climate Change estimates that the global temperature will go up another 1.8 degrees centigrade (International Panel on Climate Change 2001). The increase in global average temperatures affects certain areas more than others. The western United States, in general, is experiencing more warming than the rest of the Nation, with the 11 western states averaging 1.7 degrees Fahrenheit warmer temperatures than this region's average over the 20th Century (Saunders *et al.* 2008). California, in particular, will suffer significant consequences as a result of global warming (California Climate Action Team 2006). In California, reduced snowpack will cause more winter flooding and summer drought, as well as higher temperatures in lakes and coastal areas. The incidence of wildfires in the Golden State also will increase and the amount of increase is highly dependent upon the extent of global warming.

No less certain than the fact of global warming itself is the fact that global warming, unchecked, will harm biodiversity generally and cause the extinction of large numbers of species. If the global mean temperatures exceed a warming of two to three degrees centigrade above pre-industrial levels, twenty to thirty percent of plant and animal species will face an increasingly high risk of extinction (International Panel on Climate Change 2001, 2007). The mechanisms by which global warming may push already imperiled species closer or over the edge of extinction are multiple. Global warming increases the frequency of extreme weather events, such as heat waves, droughts, and storms (International Panel on Climate Change 2001, 2007; California

Climate Action Team 2006; Lenihan *et al.* 2003). Extreme events, in turn may cause mass mortality of individuals and significantly contribute to determining which species will remain or occur in natural habitats. As the global climate warms, terrestrial habitats are moving northward and upward, but in the future, range contractions are more likely than simple northward or upslope shifts. Many butterfly species have already experienced shifts in distribution and phenology in response to global warming (Forister and Shapiro 2003; Hill *et al.* 1999; Parmesan *et al.* 1999; Roy and Sparks 2000; Roy *et al.* 2001). Ongoing global climate change (Anonymous 2007; Inkley *et al.* 2004; Adger *et al.* 2007; Kanter 2007) likely imperils the callippe silverspot butterfly, mission blue butterfly, San Bruno elfin butterfly, Bay checkerspot butterfly, and the San Francisco garter snake and the resources necessary for their survival. Since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats, foodplants, nectar plants, prey, and/or increased numbers of their predators, parasites, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

Conclusion

After reviewing the current status of the callippe silverspot butterfly, mission blue butterfly, San Bruno elfin butterfly, Bay checkerspot butterfly, San Francisco garter snake, and the San Francisco lessingia, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Amendment to the San Bruno Mountain Habitat Conservation Plan is not likely to jeopardize the continued existence of these five species. Critical habitat for the Bay checkerspot butterfly is located within the action area, but none will be destroyed or adversely modified. Critical habitat has not been proposed or designated for the mission blue butterfly, San Bruno elfin butterfly, San Francisco garter snake, or San Francisco lessingia; therefore, none will be adversely modified or destroyed by the proposed action.

INCIDENTAL TAKE STATEMENT

Amount or Extent of Take

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

Sections 7(b)(4) and 7(o)(2) of the Act, which refer to terms and conditions and exemptions on taking listed fish and wildlife species, do not apply to listed plant species. However, section 9(a)(2) of the Act prohibits removal, reduction to possession, and malicious damage or destruction of listed plant species on Federal lands and the removal, cutting, digging up, or damaging or destroying such species in knowing violation of any State law or regulation, including State criminal trespass law. Actions funded, authorized or implemented by a Federal agency that could incidentally result in the damage or destruction of such species on Federal lands are not a violation of the Act, provided the Service determines in a biological opinion that the actions are not likely to jeopardize the continued existence of the listed plant species.

The Service anticipates incidental take of the callippe silverspot butterfly and mission blue butterfly will be difficult to detect or quantify because it is unlikely an injured or dead specimen will be found due to the elusive and cryptic nature of the early stages of these two species (eggs, larvae, pupae), their small size, and because carcasses likely will be rapidly consumed by predators or scavengers. However, the level of incidental take of these animals can be anticipated by the effects to cover, foraging, movement, and breeding habitat. Conservation measures proposed by the applicant in the San Bruno Mountain Habitat Conservation Plan and the *Description of the Proposed Action* in this biological opinion will substantially reduce, but do not eliminate, the potential for incidental take of these two listed species. The Service, therefore, anticipates incidental take of callippe silverspot butterfly and the mission blue butterfly will result from the proposed project. Upon implementation of the reasonable and prudent measures, all individuals of the callippe silverspot butterfly and the mission blue butterfly inhabiting 19.64 acres that will be developed or disturbed on the Northeast Ridge, and 2800 acres that will be managed and monitored will be subject to incidental take in the form of harm, harassment, capture, injury and mortality. The incidental take of all individuals of callippe silverspot butterfly or the mission blue butterfly within the 2800 acres may not occur during a single year (January 1-December 31). Incidental take of the callippe silverspot butterfly or mission blue butterfly as a result of expansion, maintenance, or development of radio, television or other facilities on Radio Ridge; or operation, expansion, or any development of the Quarry is not authorized by this biological opinion. Incidental take in the form of capture, injury, and/or death during capture/mark/release/recapture studies or from pesticide use is not authorized by this biological opinion.

The Service anticipates incidental take of the San Bruno elfin butterfly will be difficult to detect or quantify because it is unlikely an injured or dead specimen will be found due to the elusive and cryptic nature of the early stages of this species (eggs, larvae, pupae), their small size, and because carcasses likely will be rapidly consumed by predators or scavengers.. However, the level of incidental take of this animal can be anticipated by the effects to cover, aestivation, feeding, and breeding habitat. Conservation measures described in the San Bruno Mountain Habitat Conservation Plan and the *Description of the Proposed Action* in this biological opinion will substantially reduce, but do not eliminate, the potential for incidental take of this listed species. The Service, therefore, anticipates incidental take of San Bruno elfin butterfly will result from the proposed project. Upon implementation of the reasonable and prudent measures, all early stage individuals of the San Bruno elfin butterfly associated with fifty (50) individual Pacific stonecrop foodplants or one (1) adult of either sex per year (January 1-December 31) within the stipple areas delineated as containing habitat for this animal on Figure 8 of the Habitat

Management Plan (San Mateo County Parks Department 2007) will be subject to incidental take in the form of harm, harassment, capture, injury and mortality due to management and monitoring. Incidental take of the San Bruno elfin butterfly as a result of expansion, maintenance, or development of radio, television or other facilities on Radio Ridge; or operation, expansion, or any development of the Quarry is not authorized by this biological opinion. Incidental take in the form of capture, injury, and/or death during capture/mark/release/recapture studies or pesticide use is not authorized by this biological opinion.

Although the Bay checkerspot butterfly currently is not known to inhabit San Bruno Mountain, there is a possibility it will naturally recolonise the action area or it may be reintroduced to the site. In addition, the Service anticipates incidental take of the Bay checkerspot butterfly will be difficult to detect or quantify because it is unlikely an injured or dead specimen will be found due to the elusive and cryptic nature of the early stages of this species (eggs, larvae, pupae), their small size, and because carcasses likely will be rapidly consumed by predators or scavengers.. However, the level of incidental take of this animal can be anticipated by the effects to cover, foraging, and breeding habitat. Conservation measures described in the San Bruno Mountain Habitat Conservation Plan and the *Description of the Proposed Action* in this biological opinion will substantially reduce, but do not eliminate, the potential for incidental take of this listed species. The Service, therefore, anticipates incidental take of Bay checkerspot butterfly will result from the proposed project. Upon implementation of the reasonable and prudent measures, all individuals of the Bay checkerspot butterfly inhabiting 2800 acres will be subject to incidental take in the form of harm, harassment, capture, injury, and mortality as a result of management, and monitoring. The incidental take of all individuals of Bay checkerspot butterfly within the 2800 acres may not occur during a single year (January 1 – December 31). Incidental take of the Bay checkerspot butterfly as a result of expansion, maintenance, or development of radio, television or other facilities on Radio Ridge; or operation, expansion, or any development of the Quarry is not authorized by this biological opinion. Incidental take in the form of capture, injury, and/or death during capture/mark/release/recapture studies or pesticide use is not authorized by this biological opinion.

The Service anticipates that incidental take of the San Francisco garter snake will be difficult to detect because when their elusive nature and shyness; their tendency to seek refuge and shelter if disturbed; their seasonal or annual fluctuations in numbers potentially masking losses; the absence of recent information regarding population densities for the San Francisco garter snake on San Bruno Mountain; and any occurrences of this species along the riparian and adjacent upland areas could be difficult to detect due to relatively dense cover conditions, and because carcasses likely will be rapidly consumed by predators or scavengers. Conservation measures described in the San Bruno Mountain Habitat Conservation Plan and the *Description of the Proposed Action* in this biological opinion will substantially reduce, but do not eliminate, the potential for incidental take of this listed species. Therefore, the Service anticipates that all San Francisco garter snake inhabiting 19.64 acres that will be developed or disturbed on the Northeast Ridge and 2800 acres that will be managed and monitored will be subject to incidental take in the form of harm and harassment. The incidental take of all individuals of San Francisco garter snake within the 2800 acres may not occur during a single year (January 1 – December 31). Other forms of take of the San Francisco garter snake especially trap, capture, injury, and kill is not authorized by this biological opinion. Incidental take of the San Francisco garter snake

as a result of expansion, maintenance, or development of radio, television or other facilities on Radio Ridge; or operation, expansion, or any development of the Quarry or pesticide use is not authorized by this biological opinion.

Incidental take for this area was initially authorized under section 10(a)(1)(B) Permit Number PRT 2-9818 (Service 1983a, 1983b) pursuant to the Act. The following reasonable and prudent measure is necessary or appropriate to minimize the effects of the incidental take authorized by the amendment to the Section 10(a)(1)(B) permit.

> Any incidental take of the callippe silverspot butterfly, mission blue butterfly, San Bruno elfin butterfly, Bay checkerspot butterfly, and/or San Francisco garter snake must comply with all of the terms and conditions of the San Bruno Mountain Habitat Conservation Plan and amended section 10(a)(1)(B) Permit Number PRT 2-9818.

To be exempt from the prohibitions of Section 9 of the Act, the following term and condition, will implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

> All conservation measures described in the San Bruno Mountain Habitat Conservation Plan and the *Project Description* of this biological opinion are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement.

Reporting Requirements

Injured callippe silverspot butterflies, mission blue butterflies, San Bruno elfin butterflies, Bay checkerspot butterflies, and/or San Francisco garter snakes must be cared for by a licensed veterinarian or other qualified person such as the Habitat Management Plan biologist; dead individuals must be placed in a sealed zip-lock® plastic bag with the date, time, location of discovery, and the name of the person who found the animal; the carcass should be kept in a freezer; and held in a secure location until the Service takes custody of it. The Service must be notified within twenty-four (24) hours of the discovery of death or injury to one of these four listed species that occurs due to project related activities or if a live, injured, or dead Bay checkerspot butterfly or San Francisco garter snake is observed on San Bruno Mountain. Notification must include the date, time, and location of the incident or of the finding of the animal clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. Sightings of lie or dead individuals of the San Francisco garter snake on San Bruno Mountain must be reported to the Service and the California Department of Fish and Game within twenty-four (24) hours. Sightings of the mission blue butterfly, Bay checkerspot butterfly, San Bruno elfin butterfly, callippe silverspot butterfly, and San Francisco garter snake are to be reported in the annual report for the San Bruno Mountain Habitat Conservation Plan that is provided to the Service each year. The Service contacts are Chris Nagano, Chief of our Endangered Species Division at the Sacramento Fish and Wildlife Office (916/414-6600) or at Chris_Nagano@fws.gov, and Daniel Crum, Resident Agent-in-Charge of the Service's Law Enforcement Division at telephone

916/414-6660 or at Daniel_Crum@fws.gov. The California Department of Fish and Game contact is Scott Wilson at telephone 707/944-5563 or electronic mail at swilson@dfg.ca.gov.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any of the conservation recommendations. We propose the following conservation recommendations:

1. The Applicant should minimize the potential for adverse effects to the San Francisco lessingia from the project related activities by implementation of the conservation measures as described in the BA, DEIS, and the *Terms and Conditions* of this biological opinion.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the Amendment to the San Bruno Mountain Habitat Conservation Plan in San Mateo County, California. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions regarding this biological opinion on the amendment to the San Bruno Mountain Habitat Conservation Plan in San Mateo County, California, please contact Chris Nagano, Chief of our Endangered Species Division, at the letterhead address, electronic mail (Chris_Nagano@fws.gov) or at telephone 916/414-6600.

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